#1-TuffTEST-Pro(tm)

Professional Level PC Diagnostic Software

USER INSTRUCTIONS

91338

#1-PC Diagnostics Company

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I. INTRODUCTION

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#1-PC Diagnostics Company, the Electronic Software Distribution (ESD) division of *Windsor Technologies, Inc.*, welcomes you to the growing family of personal computer service companies, manufacturers, and support personnel who use **#1-TuffTEST-Pro** Professional Level PC Diagnostic Software as their primary and preferred troubleshooting and diagnostic tool.

#1-TuffTEST-Pro is the downloadable version of **PC-Technician(tm)**. It was developed by *Windsor Technologies*, a leader in personal computer diagnostic products since 1984, and with the assistance of their customers, whose business is the support and/or service of personal

computers. **#1-TuffTEST-Pro** is specifically designed to assist professional field service engineers in maintaining, troubleshooting, and repairing personal computers.

#1-TuffTEST-Pro contains extensive tests for main, extended, and expanded memory; fixed disk drives; diskette drives; video displays and adapters; serial and parallel interfaces; and keyboards; and is able to log errors both to the display and to a printer. **#1-TuffTEST-Pro** has an extremely friendly, function-key-driven, user interface.

#1-TuffTEST-Pro uses a proprietary loader/operating system so that software routines are as close to the hardware as possible and do not have results of various tests masked by operating system (i.e., Windows, DOS, Unix, OS/2, etc.) error recovery routines. All the diagnostic routines in **#1-TuffTEST-Pro** are written in assembly language (instead of a high-level language such as C), so they execute more efficiently, run faster and are smaller in size. In addition, the **#1-TuffTEST-Pro** program is able to relocate when executing memory tests; something that is NOT POSSIBLE UNDER DOS or other operating systems.

#1-TuffTEST-Pro is a high-precision tool dealing with complex personal computer hardware and configuration issues. Therefore, it is extremely important that you read this User Handbook prior to using **#1-TuffTEST-Pro**.

II. Systems Supported

#1-TuffTEST-Pro is professional-level diagnostic software that supports personal computers that use Intel Pentium II +MMX, Pentium Pro +MMX, Pentium +MMX, i486, 80386, 80286, 8088, 8086, and compatible AMD and Cyrix processors with Industry Standard Architecture (ISA), Enhanced Industry Standard Architecture (EISA), Micro Channel Architecture (MCA), VESA Local Bus (VLB), and Peripheral Component Inter-connect (PCI) bus configurations.

III. #1-TuffTEST-Pro -- Components and Getting Started

User Handbook:	First print AND READ.
Program Diskettes:	Make each format (3½" and/or 5¼") as required.
TEST Diskettes:	Make as required for diskette drive testing.
TEST Plugs:	Required for parallel and serial interface external tests. Make your own or buy from *#1-PC Diagnostics Company.* To order from *#1-PC Diagnostics Company*, go to:

http://www.tufftest.com/tporders.htm

IV. User Handbook

The **#1-TuffTEST-Pro** User Handbook is established as an icon after running the downloaded program, ttpsetup.exe, under Windows. It is in the Windows Write format and was compiled with the standard Windows format defaults (font style and sized for 8½" x 11" paper).

As **#1-TuffTEST-Pro** is a **"Stand-Alone"** tool, the User Handbook is not, by definition, available for use in an on-line help mode. Therefore, it is best to print the entire document prior to using **#1-TuffTEST-Pro**, so that the User Handbook is available to use as a reference guide while troubleshooting a PC.

To better understand the operation, tests, and functions of **#1-TuffTEST-Pro**, it is best to do a THOROUGH review of this User Handbook prior to using **#1-TuffTEST-Pro**. This will also insure that you will understand the User Handbook layout and contents for quick reference while involved in a **#1-TuffTEST-Pro** test session.

V. Making Program Diskettes

To use **#1-TuffTEST-Pro**, you first have to make a Program Diskette, as **#1-TuffTEST-Pro** is ALWAYS loaded from Drive A from a power-on start (cold boot).

To make Program Diskettes, select the Make a **#1-TuffTEST-Pro** Program Diskette icon from the Windows program menu and follow the easy-to-use instructions. After making a Program Diskette, remember to label it, and write-protect it as another safegard in protecting against viruses. See Section **XIV**, Protecting Against Viruses.

#1-TuffTEST-Pro Program Diskettes contain their own boot loader module, proprietary operating system (NOT Windows, DOS, Unix, OS/2, etc.) and multiple programs designed specifically for the various CPU/bus configurations that exist in the systems supported (see Section **II** above).

> NOTE: To be able to use **#1-TuffTEST-Pro** on the full range of PC configurations, it is best to make Program Diskettes in the most common format, i.e. the lowest capacity media type. While their presence is diminishing, there are still PC's that have "single mode" standard (low) capacity Drive A diskette drives that only can read 360KB DS/DD 5¼" diskettes or 720KB DS/DD 3½" diskettes. The standard (low) capacity Program Diskettes can also be used in the "dual-mode" diskette drives that primarily use 1.2MB 5¼" diskettes or 1.44MB 3½" diskettes.

VI. Making TEST Diskettes

#1-TuffTEST-Pro TEST Diskettes are required to perform the Diskette Drive Tests because TEST Diskettes are formatted with a worst-case data pattern, B6D9h (h = hexadecimal), designed to put maximum stress on the target diskette drive during testing.

To make TEST Diskettes:

1) Load **#1-TuffTEST-Pro** and then remove the Program Diskette.

2) Select [F5] Diagnostic Menu.

3) Select [F5] Storage Menu.

4) Select a) Diskette Drive Tests Menu.

5) Insert appropriate blank diskette (3½" 1.44MB/720KB or 5¼" 1.2MB/360KB).

6) Specify appropriate diskette drive.

7) Press [Enter] to continue.

8) Specify appropriate format.

9) Press [Enter] and special formatting will commence.

   NOTE: Only diskettes that format without error on both sides should be used as TEST Diskettes.

An added benefit of **#1-TuffTEST-Pro's** maximum stress format pattern, B6D9h (h = hexadecimal), is that it can also be used as a high-precision media certification test. Any errors occurring during the formatting process (on a known good diskette drive), would indicate that the diskette being tested has a marginal recording capability due to imperfections and/or wear on the diskette surface.

VII. TEST Plugs: Make or Buy

#1-TuffTEST-Pro has very powerful tests for the external operation of the parallel and serial interface ports. To use these tests, TEST Plugs (external signal loopback connectors) must be used. TEST Plugs receive an outbound signal from the interface connector and loop it back inbound to the appropriate interface connector pins, thus testing that external function of the interface.

There are three TEST Plugs used by **#1-TuffTEST-Pro**:

1 DB-25 Serial (asynchronous) TEST Plug
1 DB-9 Serial (asynchronous) TEST Plug
1 DB-25 Parallel TEST Plug

TEST Plugs can be made by the **#1-TuffTEST-Pro** licensee or they can be purchased directly from *#1-PC Diagnostics Company* (online from our Web site as indicated below).

#1-TuffTEST-Pro is designed to only use TEST Plugs with the signal loopback pin-outs indicated below. Other loopback connectors (also called wrap-plugs) available in the marketplace MAY NOT work correctly with **#1-TuffTEST-Pro**.

The **#1-TuffTEST-Pro** TEST Plug pin-outs are as follows:

Serial Port - DB 25 subminiature (female) connector:

PIN	to	PIN
2	to	3
4	to	5
4	to	6
8	to	20
9	to	18
11	to	25
20	to	22

Note that pin #4 and pin #20 are double-wire pins.

Serial Port - DB 9 subminiature (female) connector:

PIN	to	PIN
1	to	4
2	to	3
4	to	9
6	to	7
7	to	8

Note that pin #4 and pin #7 are double-wire pins.

Parallel Port - DB 25 subminiature (male) connector:

PIN	to	PIN
5	to	15
6	to	13
7	to	12
8	to	10
9	to	11

As a **#1-TuffTEST-Pro** licensee, you are authorized to make your own TEST Plugs using the above pin designations and parts that are readily available from most electronic parts suppliers and catalogs.

If you do not want to make your own TEST Plugs, you can buy TEST Plugs online from *#1-PC Diagnostics Company*. They are sold ONLY in complete sets of three, one of each type, and cost $19.95 (postage paid) in the USA, or $24.95 (postage paid) outside the USA when ordered online from our World Wide Web site at:

http://www.tufftest.com/tporders.htm

If ordered manually (not online) the cost is $25.00 per set (postage paid) in the USA, or $30.00 per set (postage paid) outside the USA.

All TEST Plugs shipments are via First Class Air Mail.

VIII. Product Overview

#1-TuffTEST-Pro's Main Menu contains five submenus. They are discussed briefly in this section and in detail in the sections specifically addressing each menu item.

VIII.A. The Configuration Menu Summary <F2>:

Options within this menu report the system's hardware configuration, verify the size of main, extended, and expanded memory, and list information about the installed Read Only Memory Basic Input/Output Services (ROM BIOS).

Additionally, **#1-TuffTEST-Pro** provides the capability to view and/or edit CMOS-based configuration information (where applicable) and view system board configuration DIP switches (where applicable).

VIII.B. The Certification Menu Summary <F3>:

Selecting this option performs the following tests: System Board; Math Coprocessor; Main, Extended, and Expanded Memory; Diskette and Fixed Disk Drives; and Serial and Parallel I/O. Any failing device reported by the Certification tests should be thoroughly tested with options from the Diagnostic Menu.

VIII.C. The Error Logging Menu Summary <F4>:

Options within this menu allow the Error Log to be displayed or cleared. It also indicates if the Error Log is full.

NOTE: The Error Log can only be cleared from this menu.

VIII.D. The Diagnostic Menu Summary <F5>:

Options within this menu perform extensive tests of main, extended, and expanded memory; diskette drives, fixed disk drives, and tape drives; keyboard; video adapter and display unit; and serial and parallel adapters. Three fixed disk drive initialization functions are included: one to mark bad tracks, another to determine and select optimum interleave factor, and a third to

perform a low-level format.

VIII.E. The Help Menu Summary <F10>:

The purpose of the Help Menu is to explain how to choose the various menus and how to select the various options within each menu.

IX. Loading #1-TuffTEST-Pro

The **#1-TuffTEST-Pro** Program Diskette contains a proprietary loader/operating system, and therefore cannot be loaded from within an operating system environment, i.e., Windows, DOS, Unix, OS/2, etc. **#1-TuffTEST-Pro** is written this way to provide greater reliability in loading and operating in systems with suspected hardware malfunctions. This feature also provides maximum protection against computer viruses.

Because **#1-TuffTEST-Pro** uses a proprietary loader/operating system, the following loading process MUST be used:

1) Turn the target computer OFF.

2) Insert a write-protected Program Diskette into Drive A.

3) Turn the target computer ON.

4) Once the Main Menu appears, remove the Program Diskette.

WARNING: DO NOT use the <Ctrl> <Alt> <Del> reset to load **#1-TuffTEST-Pro**, and DO NOT attempt to read the Program Diskette from an operating system prompt prior to loading **#1-TuffTEST-Pro**. See Section **XIV**, Protecting Against Viruses.

The **#1-TuffTEST-Pro** Program Diskette contains multiple diagnostic programs in a compressed format. Each program is written for a specific microprocessor/bus combination. As **#1-TuffTEST-Pro** loads, the micro-processor/ bus combination of the system in use is analyzed, and the appropriate program is expanded and loaded into main memory.

When using **#1-TuffTEST-Pro**, some tests may not be available. Test availability is determined by the microprocessor/bus combination of the system in use.

X. Troubleshooting Loading Failures

If the **#1-TuffTEST-Pro** Program Diskette will not load, follow these procedures:

1) Make sure the target PC's CMOS Setup is configured to boot from Drive A first. If it is, go to number 2.

2) Remove the Program Diskette from Drive A. Turn the computer OFF, carefully reinsert the Program Diskette, and turn the computer ON. Often the clamping mechanism does not quite center the diskette. If unsuccessful, go to number 3.

3) Attempt to load an application program (utility, wordprocessing, spreadsheet, etc.) from a known good diskette. If it loads, it would indicate that the Program Diskette has become damaged. Make a new Program Diskette (see Section **V**, Making Program Diskettes). If the known good diskette does not load, go to number 4.

4) The problem is probably with the diskette drive, the diskette controller board, or with the interconnecting cable. Substitute a known good interface cable and try loading the diskette. If it will not load, go to number 5.

5) Substitute a known good diskette controller board and attempt to load the Program Diskette. If it will not load, go to number 6.

6) Substitute a known good diskette drive and attempt to load the Program Diskette. If the diskette drive is not being accessed, the problem may be with the system board or with the power supply.

XI. Navigating within #1-TuffTEST-Pro

#1-TuffTEST-Pro is a menu-driven diagnostic system. All possible options and associated keystrokes necessary to initiate functions appear on the video display at all times. This eliminates the need for remembering commands or keystroke sequences.

The Main Menu graphically displays five submenus and their associated function keys. Anytime a menu and function key are visible as an option, they are available for selection. To enter the desired submenu, press the function key indicated on the display. When in a submenu, the <F1> key is used to go back one level.

In addition to menu selection with function keys, there are three other selection processes used within **#1-TuffTEST-Pro**:

1) Terminating a diagnostic routine is achieved by pressing the <Esc> key. Once the routine has stopped, pressing the <ENTER> (or <Ret>) key returns to that routine's previous menu.

2) Multiple-choice menu selection is achieved by pressing the key associated with the desired selection.

3) User-defined values may be entered where appropriate, such as specifying the memory testing range or fixed disk drive testing range.

   NOTE: Anytime four incorrect keys are used, **#1-TuffTEST-Pro** will cycle through the HELP section to review how to use function keys to move from menu to menu, and how to select items within a menu.

XII. Printing from Displays

Any **#1-TuffTEST-Pro** display can be printed by using the Print Screen key while no tests are in operation.

XIII. Exiting #1-TuffTEST-Pro

To exit **#1-TuffTEST-Pro**, the Program Diskette and TEST Diskettes must be removed from the diskette drives, and the power switch on the computer turned OFF.

XIV. Protecting Against Viruses

The **#1-TuffTEST-Pro** Program Diskette(s) will be used to troubleshoot many computers, any one of which may contain a virus. To insure the virus-free status of the Program Diskette(s) and to prevent the spread of viruses, please read the following information carefully.

#1-TuffTEST-Pro is highly resistant to virus infection when used according to the instructions provided below because it does not operate under an operating system (i.e., Windows, DOS, Unix, OS/2, etc.).

Since most viruses use the operating system environment to inflict their damage, keeping the Program Diskette(s) from interacting with the operating system environment provides maximum protection against viruses. NEVER do an operating system directory command (DIR) or in any other way attempt to read a Program Diskette from within an operating system.

To protect the Program Diskette(s) from viruses:

1) Always turn the computer OFF before inserting a Program Diskette into Drive A.

2) Verify that the Program Diskette is write-protected.

3) Never use the <Ctrl> <Alt> <Del> reset to load or reload **#1-TuffTEST-Pro**.

4) Remove the Program Diskette once the Main Menu is displayed.

Carefully following the above guidelines will provide maximum protection against viruses contaminating Program Diskette(s).

If virus contamination should occur, make a new Program Diskette on a virus-free computer (see Section **V**, Making Program Diskettes).

XV. Technical Support

Technical support is available at no charge during normal business hours via e-mail at:

1ttpsupport@tufftest.com

XVI. Upgrade Information

Once you license **#1-TuffTEST-Pro** you are eligible to buy upgrades for life. For your convenience, upgrades are always totally backward compatible so you never have to worry about using your old diskettes with your new diskettes.

"Any" older version of **#1-TuffTEST-Pro** can be upgraded to the current version. To upgrade, all we need is your **#1-TuffTEST-Pro** Serial Number when you place your order through our online 24-hour automated ordering system

The cost of a **#1-TuffTEST-Pro** upgrade varies depending upon the size and scope of the upgrade. Minor upgrades and patches are usually available at no charge.

Information on the current version and how to order it is always available at our World Wide Web site at:

http://www.tufftest.com/ttp01.htm#Upgrade Policy

NOTE: **#1-TuffTEST-Pro** licensees - to determine your version number, load **#1-TuffTEST-Pro**. The complete version number is shown on every display.

XVII. Documentation Organization

In general, this User Handbook follows the process of using **#1-TuffTEST-Pro** and the order of the various menus and submenus. Due to the differences in the microprocessor/bus combinations, the sequence or number of some menu/submenu items may vary.

Primary menus and submenus are accessed via the keyboard function (F) keys with options within those menus accessed by the keyboard's lower case alpha keys. The documentation indicates the function key in < > following the test/function title, with the keys for options within menus indicated in ( ).

XVIII. USING #1-TuffTEST-Pro

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XVIII.A. Configuration Menu <Main Menu F2> :

The Configuration portion of **#1-TuffTEST-Pro** contains some or all of the following selections, depending on the type of computer being tested:

XVIII.A.1. Current Configuration:

Selection of this option displays the current configuration of the computer. In addition, a **CPU Speed Test** is performed and **MMX Extensions** are tested. **#1-TuffTEST-Pro** reads the configuration information reported by the computer's ROM BIOS and by its SCSI drivers. The reported data is then listed on the video display.

When **#1-TuffTEST-Pro** is run on a Compaq computer (80386/20), the following additional information is listed. This information is specific to Compaq computers only:

- System ROM Revision and Family
- Video ROM Revision and Family
- Fixed Disk Drive Controller ROM Revision
- Keyboard Controller ROM Revision, Family and Code

NOTE: **#1-TuffTEST-Pro** determines the speed of the installed microprocessor by using algorithms to test its internal clock. This is the actual speed of the microprocessor (in MHz). This report should not be confused with a benchmark, as it does not reflect the actual speed of the computer as affected by memory speed, wait states, fixed disk drive speed, etc. Also note that due to CMOS and other system settings, the speed may vary from the speed rating of the processor.

NOTE: The displayed BIOS Release Date often differs from the date displayed in the copyright message during system initialization. The BIOS release date displayed by **#1-TuffTEST-Pro** is the actual release date in the BIOS code, not the updated copyright information.

XVIII.A.2. Switch Positions:

This selection graphically displays the current system board switch settings (PC, PC XT and compatible computers).

NOTE: The switch settings displayed are those of the IBM-branded PC and PC XT. If this product is being used to test non-IBM-branded PC or PC XT compatible computers, the switch settings may differ from the actual system board switch configuration.

XVIII.A.3. System Memory Size:

Main memory size (to 640K) is displayed in a bar graph format. The display contains both memory size as reported by the ROM BIOS and memory size as detected by **#1-TuffTEST-Pro**. If the two memory size reports are not the same, CMOS configuration should be checked.

NOTE: **#1-TuffTEST-Pro** reports the amount of main memory that is actually usable by an operating system or an application program. Some computers reserve a small amount of main memory (usually 1K to 2K) for internal use, making it inaccessible to operating systems or application programs. In these instances, **#1-TuffTEST-Pro** will report a System Memory Size that is smaller than expected (such as 638K or 639K, versus the expected 640K).

XVIII.A.4. Extended Memory Size:

Extended memory starts at 1024K. Its size is displayed in a bar graph format. The display contains both memory size as reported by the ROM BIOS and memory size detected by **#1-TuffTEST-Pro**. If the memory sizes reported are not the same, CMOS configuration should be reviewed.

XVIII.A.5. Expanded Memory Size:

Expanded memory size is displayed in a bar graph format. The display contains both memory size as reported by the ROM BIOS and memory size detected by **#1-TuffTEST-Pro**. If the memory sizes reported are not the same, CMOS configuration should be checked.

XVIII.A.6. CMOS Configuration:

The current status of the CMOS Configuration is displayed when this item is selected.

XVIII.A.6.a. ISA/EISA/VLB/PCI Computer Systems

The CMOS Configuration can also be initialized or modified from this selection.

NOTE: If the CMOS Configuration is modified, changes will not become effective (except

for date and time) until the next time the computer is turned OFF and then ON again.

XVIII.A.6.b. Micro Channel Architecture (MCA) Computer Systems:

The actual configuration cannot be permanently modified using **#1-TuffTEST-Pro** because of IBM's use of proprietary Adapter Definition Files (ADFs) in its setup program.

NOTE: Where **#1-TuffTEST-Pro** uses CMOS to identify devices (such as diskette drive B: and fixed disk drives C: and D:), they will be displayed as "Not Available," since MCA computers do not use CMOS in the traditional ISA/EISA fashion.

XVIII.B. Certification Menu <Main Menu F3>:

The Certification portion of **#1-TuffTEST-Pro** consists of a number of discrete diagnostic routines. These single tests, when run as a group, allow the testing of an entire computer system. TEST Diskettes and TEST Plugs must be inserted before running the certification tests.

The Certification Menu within **#1-TuffTEST-Pro** provides two testing options: the Abbreviated System Test and the Extensive System Test. Prior to running the Abbreviated System Test or the Extensive System Test, the Test Selection Menu is presented which allows individual tests to be selected or deselected prior to executing either of these two testing options. When the asterisk (*) is displayed next to the listed system resource, the individual test for that particular system resource is part of the set of diagnostic routines to be performed. When the asterisk (*) is not displayed, the diagnostic routine associated with the listed system resource is not performed. The default setting is for all tests to be selected and performed. Choose the appropriate letter to select or deselect a test.

XVIII.B.1. Abbreviated System Test:

This test performs the diagnostic routines once and then terminates. Its purpose is to perform a single-pass verification of the entire system, including all installed devices.

XVIII.B.2. Extensive System Test:

The diagnostic routines performed under this option are exactly the same as the Abbreviated System Test, except that this option adds the Marching Ones and Walking Ones memory tests and repeats the tests continuously until the operator intervenes by pressing the <Esc> key. It may be used to burn-in a system (running it under stress for an extended period of time to certify operation), to detect intermittent failures, or to certify newly installed/repaired devices.

XVIII.B.3. Interpreting the Certification Menu Display Information:

The Abbreviated and Extensive System Tests are compilations of many system component tests. These tests, along with information regarding the resulting error codes for each test module, are described below.

XVIII.B.3.a. System Board

If the system passes, a report of "OK" will be displayed. A report of "FAILED" would indicate that system board replacement or further chip-level troubleshooting using other equipment might be appropriate.

XVIII.B.3.b. Math Coprocessor:

This diagnostic routine tests the math coprocessor by performing write/read/compare operations to its internal registers. Its status is reported as "OK," "FAILED," or "NOT INSTALLED." If a math coprocessor other than an Intel-branded math coprocessor is installed (i.e., Weitek), it will not be detected.

XVIII.B.3.c. Main Memory:

The installed memory is subjected to four types of write/read/compare tests: ALLZEROS, ALLONES, CHECKERBOARD, and ADDRESS. In the ALLZEROS test, zeros are written to all memory locations followed by a read/compare operation. Any memory location not containing a zero is reported as "FAILED," and an error code is displayed. The same procedures are followed in the ALLONES test, except that ones are written to all memory locations. The CHECKERBOARD test alternately writes zeros and ones to successive memory locations and verifies through read/compare operations that the memory location contains the correct value. If a discrepancy is detected, an error code is displayed.

The first three memory tests (ALLZEROS, ALLONES and CHECKERBOARD) generate data bytes having an even number of ones, and therefore do not provide maximum stress testing of the parity generators. The fourth memory test, ADDRESS, generates data having approximately the same number of bytes with an even number of ones as those with an odd number of ones, imposing greater stress conditions on the parity generators. If errors occur, the main memory should be further tested using the routines available from the Diagnostic Menu <MM F5>.

NOTE: The Extensive System Test adds the more rigorous Marching Ones and Walking Ones memory tests.

XVIII.B.3.d. Extended Memory:

#1-TuffTEST-Pro tests extended memory using the same procedures as for main memory. If errors occur, the extended memory should be further tested using the routines available from the Diagnostic Menu <MM F5>.

XVIII.B.3.e. Expanded Memory:

#1-TuffTEST-Pro tests expanded memory using the same procedures as for main memory. If errors occur, the expanded memory should be further tested using the routines available from the Diagnostic Menu <MM F5>.

XVIII.B.3.f. Diskette Drives:

This test is comprised of two parts: The Start test and the Write/Read test. In the Start test, the diskette drive is accessed to verify that the diskette drive controller is functioning properly. The Write/Read test writes a maximum stress test pattern, B6D9h (h = hexadecimal), and verifies through a read/compare operation that the test pattern has not changed. Any discrepancies are reported as "FAILED," and an error code is reported. If errors occur, the diskette drive should be further tested using the routines available from the Diagnostic Menu <MM F5>.

If a second diskette drive is installed, it is also tested.

XVIII.B.3.g. Fixed Disk Drive:

Testing of the fixed disk drive in this portion of **#1-TuffTEST-Pro** is limited to non-destructive tests. If errors occur, the fixed disk drive should be further tested using the routines available from the Diagnostic Menu <MM F5>.

XVIII.B.3.h. Serial Input/Output (I/O):

Both the internal operation and interface of the serial (asynchronous) I/O adapter(s) are tested.

In the internal test, the Universal Asynchronous Receiver Transmitter (UART) or Universal Synchronous/Asynchronous Receiver Transmitter (USART) is switched into the test mode, enabling **#1-TuffTEST-Pro** to test its internal registers without transmitting data. While in this mode, data is written in parallel format to the UART/USART which converts it to serial data, internally loops it back within the UART/USART, then reconverts it to parallel data. The reconverted data is then read and compared by **#1-TuffTEST-Pro**. If a discrepancy is detected, an error code is displayed indicating that the Data Test failed and the failing bit(s) are displayed.

The interface test requires the DB-25 Serial TEST Plug (the yellow plug if purchased from *#1-PC Diagnostics Company*) and/or the DB-9 Serial TEST Plug (the green plug if purchased from *#1-PC Diagnostics Company*) to be inserted into the DB-25 and/or DB-9 connector on the back of the serial adapter. During this test, **#1-TuffTEST-Pro** causes the UART/USART to send data out via the interface connector and receive it back after it is looped through the TEST Plug. It also sends and receives the handshake signals. **#1-TuffTEST-Pro** then reads the Modem Status Register in the UART/USART and displays an error code if the expected values of the status bits

are not correct.

If errors occur, the serial interface should be further tested using the routines available from the Diagnostic Menu <MM F5> followed by Serial <DM F6>.

XVIII.B.3.i. Parallel Input/Output (I/O):

The test routines for the parallel (I/O) adapter card(s) contain two parts: internal testing and interface testing.

The internal testing involves writing, reading, and comparing data and control signals through the circuitry. If the data and control signals match, an OK status is reported. If they do not match, a failure is reported along with an error code.

The interface testing requires the DB-25 Parallel TEST Plug (the blue plug if purchased from *#1-PC Diagnostics Company*) to be inserted into the DB-25 connector on the back of the parallel adapter. The test involves feeding back five of the eight parallel data lines through the five status reporting pins, emulating the status signals that would normally originate from the printer. The data is sent out and received back with the Data, Control, and Status words indicated as "PASSED" or "FAILED." For each failing word, an error code is displayed indicating the failing bit(s).

If errors occur, the parallel interface should be further tested using the routines available from the Diagnostic Menu <MM F5> followed by Parallel <DM F4>.

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XVIII.C. Error Logging Menu <Main Menu F4>:

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The Error Logging facility can maintain up to 180 errors in four pages of 45 errors each. The Error Log format of "Errors -Code" indicates the total number of errors for each separate and unique error code. Consult the individual tests below for the error codes generated.

The Error Logging feature of **#1-TuffTEST-Pro** is automatically enabled when **#1-TuffTEST-Pro** is loaded. When the Error Logging Menu option is selected, the following choices are displayed for selection:

(a) Display Log: Displays the currently logged errors.

(b) Clear Error Log: Deletes all currently logged errors.

NOTE: Although the Error Log can be viewed from numerous menus, clearing the log can only be done from the Error Logging Menu.

If there are enough errors to fill the log, the lower right corner of the current screen will display a blinking "Error Log is Full" message.

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XVIII.D. Diagnostic Menu <Main Menu F5>:

The Diagnostic Menu selections provide the majority of **#1-TuffTEST-Pro's** power and precision. Each major system component/component group has a separate menu selection, extensive tests, and appropriate displays which indicate the activity and errors found. The precision and stressfullness of the tests represent the maximum amount possible using a RAM resident program. Each is engineered to be easy to learn and use. It is strongly suggested that this section's documentation be thoroughly reviewed as part of using **#1-TuffTEST-Pro**.

XVIII.D.1. Keyboard Menu <Diagnostic Menu F2>:

The Keyboard Test verifies the functionality of every key position on the keyboard, as well as multiple-key combinations. For each key or keys pressed, the ASCII hex code and the keyboard scan code are displayed along with a graphic representation of the key(s) pressed. The ASCII hex code and keyboard scan code displayed should be compared with the standards established by IBM.

NOTE: Keys that have specific system functions will still perform those functions.

When the <PrtSc> (print screen) key is pressed, the BIOS printing routine will attempt to send the image on the video display to a printer at LPT1. If a printer is not attached, or the attached printer is offline or otherwise disabled, the system will hang for an indeterminate period of time. To bypass the printing function, hold down the <Ctrl> key while pressing the <PrtSc> key.

When the <Pause> key is pressed, the BIOS pause routine will take effect. The system will not continue until the <Pause> key is pressed again. To bypass the pause function, hold down the <Ctrl> key while pressing the <Pause> key.

Upon selection of the Keyboard Test, some of the following selections will be listed, which may vary, depending on the target computer:

XVIII.D.1.a. PC-Style Keyboard (10 Function Keys):

This item should be selected if the keyboard has ten function keys along the left or across the top.

XVIII.D.1.b. Enhanced Keyboard (12 Function Keys):

This item should be selected if the keyboard has twelve function keys across the top.

XVIII.D.1.c. AT-Style Keyboard (10 Function Keys):

This item should be selected if the keyboard has ten function keys along the left, or across the top.

XVIII.D.1.d. 102-Key Enhanced Keyboard (European Distribution):

This item should be selected if the keyboard has 102 keys and supports the European character set.

XVIII.D.1.e. NCR PC-8 Keyboard (30 Function Keys):

This item should be selected if the system being tested is an NCR PC-8.

XVIII.D.2. Display Menu <Diagnostic Menu F3>:

#1-TuffTEST-Pro's display tests are designed to visually verify correct operation of the display via the alignment tests, and to test the operation and components of the video adapter and memory via the video adapter tests.

NOTE: When the computer contains a Black on White VGA display, the menu headers will not be visible. This can be corrected by pressing the <V> key at the Main Menu.

XVIII.D.2.a. Alignment Aids:

The alignment aids verify that the alignment circuitry is functioning properly. Convergence and other alignment issues can be determined by observing changes in the various patterns in the corners versus the center of the display. Any irregularities in the appearance of the display indicate a need for servicing the video display unit. The following alignment patterns are available:

XVIII.D.2.a.i. Cross-Hatch Pattern

XVIII.D.2.a.ii. Dot Patterns

XVIII.D.2.a.iii. Vertical Bars

XVIII.D.2.a.iv. Horizontal Bars

XVIII.D.2.a.v. Text Color Chart:

This pattern verifies proper focusing and operation of the red, green, and blue color guns. Inconsistencies in color quality and the displayed color patterns indicate a need for service.

XVIII.D.2.b. Video Adapter Tests:

XVIII.D.2.b.i. Verify Screen Memory Test:

This test writes every ASCII character with all possible attributes to each screen location. A successful screen memory test displays a sequential series of Xs. If any character other than an X is displayed at any character location on the video display (including a space), a screen memory failure is indicated.

Screen memory for monochrome displays consists of 4K of screen memory (one page). Screen memory for color displays consists of 16K of screen memory (four pages). The screen memory tests on systems using monochrome displays scan the screen one time, displaying the test results of the one page of screen memory. The screen memory test with systems having color displays scans the screen four times, displaying the test results of the four pages of memory.

XVIII.D.2.b.ii. Character Set:

This test verifies the proper operation of the video character generator ROM. The entire standard and extended ASCII character sets are displayed. This display should be carefully compared to the established standard. Incorrect or missing characters indicate a problem with the character generator and/or the display adapter.

XVIII.D.2.b.iii. Video Attributes:

All possible combinations of video attributes are displayed on the screen: blinking, underlined, reverse, normal and high intensity, and blank. The display should be carefully checked to verify the attribute specified is correct. If it is not correct, a faulty video display adapter is indicated.

XVIII.D.2.b.iv. Fill Display with a Character:

This test fills the display with a character selected by the user. Any incorrectly displayed character or a blank indicates a failure of screen address generation, screen memory, or the video character generator ROM. In any of these cases, a failure indicates a problem with the video display adapter.

XVIII.D.2.b.v. Test Cursor Addressing:

This test successively places the cursor in different screen locations, giving the appearance of smaller and smaller rectangles on the screen. The display should be carefully monitored by the user for breaks in the rectangles. Any break indicates a problem with cursor addressing and/or screen memory, both of which may be caused by a problem with the video display adapter.

XVIII.D.2.b.vi. EGA/MCGA/VGA Submenu:

(EGA = enhanced graphics adapter; MCGA = multicolor graphics array; VGA = video graphics array). If and only if **#1-TuffTEST-Pro** identifies the presence of an EGA, MCGA, or VGA video display adapter, the displayed menu offers three options:

XVIII.D.2.b.vi.a. Test Video Memory:

Selecting this option tests each installed video memory bank using the WALKING ONES Memory Test. The status of each bank is reported.

XVIII.D.2.b.vi.b. Display High-Resolution Color Charts:

This test verifies proper focusing and operation of the Red, Green, and Blue color guns in the high-resolution mode. Inconsistencies in the color patterns displayed indicate a need for service.

XVIII.D.2.b.vi.c. Test Text Resolution:

This test displays the ASCII character set in three resolution modes: 35 x 80, 42 x 80, and 50 x 80.

NOTE: When the computer contains multiple video display adapters, all but the adapter to be tested must be removed.

XVIII.D.3. Parallel Menu <Diagnostic Menu F4>

XVIII.D.3.a. Overview:

#1-TuffTEST-Pro provides extensive testing for all standard parallel (IBM/Epson-type) communication interfaces (LPT1, LPT2, and LPT3 ports) at the standard addresses, both internally and externally.

The parallel interface was designed to communicate with a printer, although other devices that communicate via the standard can be used. It is also designed to predominately be a one-way

communicator, rapidly and efficiently transferring data to be printed.

The computer's BIOS controls the basically "dumb" parallel interface by directing the requests of the operating system (example -the DOS Print Screen command) or application program's requests to the interface. The interface receives the data, i.e., 8-bit characters in parallel, sends a CONTROL word to initialize the printer, receives back a STATUS word indicating the printer is initialized and ready to receive and handle (print) the data. Refer to the Error Code charts below for the CONTROL and STATUS word possibilities.

The process as described above is based on a character-by-character communication view. The interface can always operate faster than any of the currently available printers can print, thus the interface is always waiting on the printer. To make the process of the interface more efficient, memory buffers were introduced in the computer and then also in the printer thus allowing larger amounts of characters to be transferred through the interface while not requiring the full and continuous attention of the PC's BIOS and actual printing by the printer.

XVIII.D.3.b. Parallel Interface Architecture:

The Interface (Signal Loopback) Test validates that the interface circuitry is sending CONTROL words (signals) and DATA and receiving, via the TEST Plug, a looped-back signal that emulates the possible return STATUS words (signals). Once the interface is determined to be operating correctly, the other tests are designed to operate with a printer connected to determine if the computer is sending correctly and that the printer is receiving, printing, and responding correctly. As described below, some of the tests operate in a delayed fashion based on the computer/printer buffer configuration.

The parallel interface is comprised of electrical components and circuits either on a separate add-in board that fits into a bus slot, as part of several functions on an add-in board, or mounted directly on the system board.

In all configurations, the interface resides at a set "port" address from which it communicates with the bus and to the outside world via a DB-25 (female is standard) 25-pin connector.

Within the interface, there are three 8-bit registers for DATA, CONTROL, and STATUS "words." The DATA register is loaded with bits coming off the bus in parallel form. These 8 bits represent the standard American Standard Code for Information Interchange (ASCII) character set (128 characters) and the extended set (standard 128 plus an additional 128 characters).

The CONTROL and STATUS registers' 8 bits are only partially used, as there are only 4 CONTROL word bit configurations and 5 STATUS word bit configurations. The location of the "on" or "1" bits in each word are equated and physically mapped to a separate and unique pin in the DB-25 connector.

XVIII.D.3.b.i. Standard Pin Values for IBM/Epson DB-25 Parallel Connector:

Signal Name	Pin	DATA/CONTROL/ STATUS Word	Description
Strobe	1	CONTROL (Out)	Output signal - the 8 data lines can be read

Data bit 0-7	2-9	DATA (Out)	5 volts = logical 1 0 volts = logical 0
Acknowledge	10	STATUS (In)	Input signal - data received
Busy	11	STATUS (In)	Input signal - Do Not Transmit
Paper Out	12	STATUS (In)	Input signal - printer is out of paper
Select	13	STATUS (In)	Input signal - printer is on line, ready to receive
Auto/Feed	14	CONTROL (Out)	Output signal selecting the line feed option. If the signal is low, the printer is commanded to automatically feed one line when it detects a carriage return; if the signal is high, an explicit line-feed character is required.
Error	15	STATUS (In)	Input signal - error
Initialize	16	CONTROL (Out)	Output signal resetting the printer to its default operating parameters
Select	17	CONTROL (Out)	Output signal to switch the printer on and off line
Ground	18-25		Ground

NOTE: The displays for Echo the Keys Pressed to a Printer, Monitor Handshake and Data Signals While Printing, and Monitor Status Signals from a Printer indicate either "active high" (+) or "active low" (-) for each of the signal names.

XVIII.D.3.c. Parallel Interface Testing

XVIII.D.3.c.i. Interface (Signal Loopback) Test:

The DB-25 Parallel TEST Plug (the blue plug if purchased from *#1-PC Diagnostics Company*) must be inserted into the DB-25 connector on the back of the parallel adapter for the interface selected. The test involves feeding back five of the eight parallel data lines through the five status reporting pins, emulating the status signals that would normally originate from the printer. The data is sent out and received back with the Data, Control, and Status words indicated as "PASSED" or "FAILED." For each failing word, an error code is displayed indicating the failing bit(s).

XVIII.D.3.c.ii. Send the ASCII Character Set to a Printer:

This test sends a printer initialization control word and continuously sends the entire ASCII character set in the classic "barber pole" format to the printer attached to the selected interface. It also displays the characters that are being sent to the printer. The printer output can be verified

by comparison with the display output.

NOTE: Some printers with buffers do not print until the buffer is full or a carriage return has been received. Accordingly, there may be a delay before a line is printed after the test begins. A delay should not be more than a few seconds as parallel interfaces transfer data at an extremely high rate of speed.

XVIII.D.3.c.iii. Echo the Keys Pressed to a Printer:

This test permits the user to select the character to be printed via the keyboard and echoes (prints) it on the printer. As each character is selected, the active data and control lines are highlighted on the display.

NOTE: Some printers with buffers do not print until the buffer is full or a carriage return has been received. Accordingly, there may be nothing printed until many keys (not including the ENTER key) have been pressed or until the ENTER key is pressed. Printer buffers of 80 characters or more must be completely filled before it will print a line. To confirm that the printer is ready for a thorough test, start by pressing the ENTER key once or twice. The paper should advance one line each time ENTER is pressed. If it does not, check to see that the printer is on line, that the cable between it and the computer is securely connected, and that paper is properly loaded in the printer.

XVIII.D.3.c.iv. Monitor Handshake and Data Signals While Printing:

This test sends the entire ASCII character set to the printer one character at a time in the same sequence as the Send ASCII Character Set Test. As each character is sent, the active data and control lines are highlighted on the display.

NOTE: Some printers with buffers do not print until the buffer is full or a carriage return has been received. Accordingly, there may be a delay before a line is printed after the test begins. A delay should not be more than a few seconds as parallel interfaces transfer data at an extremely high rate of speed.

XVIII.D.3.c.v. Monitor Status Signals from a Printer:

This test verifies the functionality of the status word sent from the printer. The status word signals are Acknowledge, Busy, Paper-out, Select, and Error. Verification of the Paper-out signal is accomplished by inserting a single sheet of paper into the printer and then removing it. Verification of the Error, Select, Acknowledge, and Busy signals is made by turning the printer on and off.

XVIII.D.3.c.vi. Display Error Log:

This selection displays the Error Log. See the Error Logging Menu section in Section **XVIII.C** for complete information.

XVIII.D.3.d. Parallel Interface Error Codes:

Parallel error code format is Pit-xx where:

P = Parallel error

i = Interface that failed (1 -3)
- 1 = Interface 1 (LPT1)
- 2 = Interface 2 (LPT2)
- 3 = Interface 3 (LPT3)

t = Test number where:
- 1 = Data test
- 2 = Control test
- 3 = Interface status test

xx = Bits that failed where:
- x = Value of 1st x
- x = Value of 2nd x

The "xx" portion indicates a status code or error code, depending on the test. Each "x" is expanded into 4 bits via the Parallel Interface Error Bit Chart in Section **XVIII.D.3.e**. Equate the "FAILED" bits to the status or error code explanation chart for each test below.

XVIII.D.3.d.i. Data Test:

Each bit in the "xx" error code represents a data bit in the internal circuitry. An error code where the two xx's = 01 indicates that bit position 0 (oooo oooF) failed the test, and an error code where the two xx's = FF indicates 2that ALL bits (FFFF FFFF) failed the test.

	1st 'x'	2nd 'x'
Bits	7 6 5 4	3 2 1 0

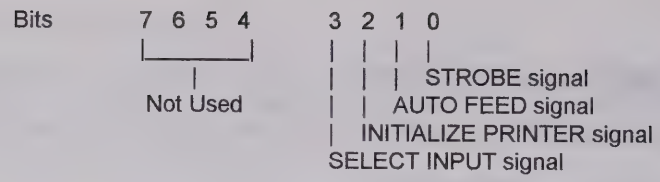
For example, an "xx" error code of 42 (oFoo ooFo) indicates that bits 6 and 1 failed.

NOTE: Refer to the Parallel Interface Error Bit Chart in Section **XVIII.D.3.e** for the "xx" error code values.

XVIII.D.3.d.ii. Control Test:

Each bit in the "xx" error code represents a control bit in the internal circuitry. Bits 4-7 are not used in the error code. An error code where the two xx's = 01 indicates that bit position 0 (oooo oooF) failed the test, and an error code where the two xx's = FF indicates that ALL bits (FFFF FFFF) failed the test.

	1st 'x'	2nd 'x'

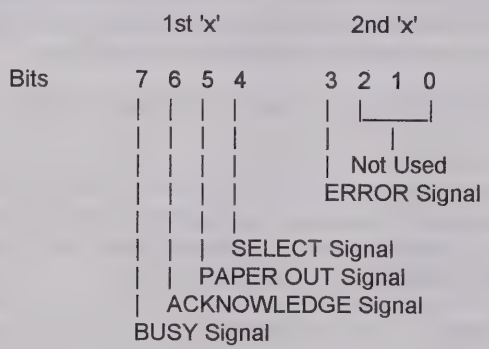


For example, an "xx" error code of 08 (oooo Fooo) indicates that bit 3 (SELECT INPUT signal) failed.

NOTE: Refer to the Parallel Interface Error Bit Chart in Section **XVIII.D.3.e** for the "xx" error code values.

XVIII.D.3.d.iii. Interface Status Test:

Each bit in the "xx" error code represents a status bit in the external interface. The lower three bits (0-2) are not used in the error code. An error code where the two xx's = 01 indicates that bit position 0 (oooo oooF) failed the test, and an error code where the two xx's = FF indicates that ALL bits (FFFF FFFF) failed the test.



This test requires that the DB-25 Parallel TEST Plug be connected to the interface being tested. If the TEST Plug is not installed, all status bits will indicate "FAILED" (an "xx" error code of F8).

For example, an "xx" error code of 80 (Fooo oooo) indicates that bit 7 (BUSY signal) failed.

NOTE: Refer to the Parallel Interface Error Bit Chart in Section **XVIII.D.3.e** for the "xx" error code values.

XVIII.D.3.e. Parallel Interface Error Bit Chart:

	BIT POSITION				BIT POSITION			
	7	6	5	4	3	2	1	0
Value of:	1st "x"				2nd "x"			

0	=	o	o	o	o	0	=	o	o	o	o
1	=	o	o	o	F	1	=	o	o	o	F
2	=	o	o	F	o	2	=	o	o	F	o
3	=	o	o	F	F	3	=	o	o	F	F
4	=	o	F	o	o	4	=	o	F	o	o
5	=	o	F	o	F	5	=	o	F	o	F
6	=	o	F	F	o	6	=	o	F	F	o
7	=	o	F	F	F	7	=	o	F	F	F
8	=	F	o	o	o	8	=	F	o	o	o
9	=	F	o	o	F	9	=	F	o	o	F
A	=	F	o	F	o	A	=	F	o	F	o
B	=	F	o	F	F	B	=	F	o	F	F
C	=	F	F	o	o	C	=	F	F	o	o
D	=	F	F	o	F	D	=	F	F	o	F
E	=	F	F	F	o	E	=	F	F	F	o
F	=	F	F	F	F	F	=	F	F	F	F

o = passing (ok), or OFF status
F = failing, or ON status

For example, an "xx" error code of 02 would have the value of oooo ooFo and would indicate that bit 1 was failing. An "xx" error code of 4A would be oFoo FoFo, indicating bits 6, 3, and 1 were failing.

XVIII.D.4. Storage Menu <Diagnostic Menu F5>:

Selection of the Storage Menu displays the following device selection choices:

Diskette Drive Tests

ST506/412 and ESDI Fixed Disk Drive Tests

IDE Fixed Disk Drive Tests

SCSI Fixed Disk Drive Tests

SCSI Tape Drive Tests

XVIII.D.4.a. _ Diskette Drive Test Menu:

#1-TuffTEST-Pro performs tests and functions on high-density 3½" (1.44MB), standard 3½" (720KB), high-capacity 5¼" (1.2MB) and standard 5¼" (360KB) diskette drives to verify the controller/controller board and/or the drive's mechanical functions and electrical integrity.

Some of the following selections perform read and/or write operations. Therefore, the Program Diskette must be removed and TEST Diskette(s) inserted into each diskette drive. If the Program Diskette is detected in the selected drive, the message, "Program Diskette in Drive, Remove

Before Continuing" will be displayed.

The special **#1-TuffTEST-Pro** TEST Diskettes must be used. See Making TEST Diskettes in Section **VI**. The TEST Diskettes have a very stressful data pattern to verify that the drive is operating at specifications and that it can change "mode" appropriately on dual-mode drives (where two storage sizes are available: 3½" 1.44MB/720KB and 5¼" 1.2MB/360KB).

Using the correct media (diskette) type is important when working with dual-mode drives. High-Density (3½") and high-capacity (5¼") media will work for all standard-media functions. However, the opposite is not reliable. Results are unpredictable if high-capacity/high-density functions are attempted on standard media.

Some diskette drives may indicate soft ("S") errors on some tests due to the speed of the select/initialization process of the drive versus the speed of the system in which it is installed. Disregard soft errors on track zero, sector zero.

XVIII.D.4.b. Diskette Drive Tests and Functions

XVIII.D.4.b.i. Specify Diskette Drive to Test:

THIS OPTION MUST BE SELECTED FIRST. This is used to select the diskette drive to be tested. Upon selection, **#1-TuffTEST-Pro** checks for the presence of the drive, and determines whether a TEST Diskette is inserted. If no TEST Diskette is detected or no diskette to be made into a TEST Diskette, **#1-TuffTEST-Pro** will return the message: "To test the diskette drive, insert a TEST Diskette or, to make a TEST Diskette, insert a blank diskette."

XVIII.D.4.b.ii. Rotational Timing Test:

This test graphically displays the rated rotational speed of the diskette drive vs. the actual rotational speed of the diskette. If the speed deviates more than plus or minus 3% from the correct speed, the drive should be serviced or replaced.

XVIII.D.4.b.iii. Seek/Read Test:

This test seeks the first sector of every track and reads the data contained in that sector. The purpose of this test is to verify the ability of the controller to recognize specific track and sector identifications and of the write/read head assembly to move to and read all tracks and sectors. Any errors are reported in the error portion of the display along with the track, sector, and head identification.

XVIII.D.4.b.iv. Write-Protect Verification Test:

CAUTION!! SELECTION OF THIS TEST MAY DESTROY SOME DATA ON THE DISKETTE.

The purpose of this test is to verify proper functioning of the write-protect switch/sensor and circuitry. Prompts are given to first insert a TEST Diskette that is write-protected and then to insert a TEST Diskette that is not write-protected. To write-protect a TEST Diskette, use a write-protect tab to cover the write-protect notch on a 5¼" TEST Diskette or move the slide to the open position on a 3½" TEST Diskette. Upon completion, a message is displayed indicating whether the test "PASSED" or "FAILED."

XVIII.D.4.b.v. Read-Only Test:

This test reads all sectors on the entire diskette surface. As the sectors are read, a graphic display follows the progression of the write/read heads as they move from track to track and from sector to sector. Errors are reported with an "S" for a soft error and an "H" for a hard error. A soft error is an initial error found in any given sector. When the controller detects an initial error, it performs five read operations of that sector in an attempt to achieve a non-error status. If these attempts produce a successful read operation of that sector, the graphic display report continues to show an "S" in the sector being read, and also logs on the display the fact that a soft error occurred. If an error-free read operation is not achieved after five attempts, the "S" report changes to "H," indicating a hard error. A hard error is defined as a failure of the controller to achieve an error-free read operation after five attempts.

XVIII.D.4.b.vi. Format Test/Make TEST Diskette:

CAUTION!! SELECTION OF THIS TEST WILL DESTROY ALL DATA ON THE DISKETTE.

This test formats the diskette using an extremely stressful data pattern, B6D9h (h = hexadecimal). It then reads the data pattern, and compares it with the known written pattern. As the diskette is formatted and written to, the sectors and tracks affected are graphically displayed on the screen with a "-" indicating a format of that sector is in progress and a "+" indicating a write operation is in progress. The error codes displayed are the same as the Read-Only Test. If any errors are reported, this indicates a problem with the diskette drive controller, the media itself, or the index sensor.

This function is also used to create **#1-TuffTEST-Pro** TEST Diskettes. See Making TEST Diskettes in Section **VI**.

XVIII.D.4.b.vii. Write/Read/Verify Test:

CAUTION!! SELECTION OF THIS TEST WILL DESTROY ALL DATA ON THE DISKETTE.

This test writes a worst-case data pattern, B6D9h (h = hexadecimal), to all sectors of the diskette and then performs a read and compare operation. Progress of the write/read operations is graphically displayed and errors are reported as described in the Read Only Test.

XVIII.D.4.b.viii. Select Testing Range:

This function allows user selection of a particular portion of the diskette for testing. This is helpful

because some diskette drive tests can take a considerable amount of time. If a particular portion of the diskette, drive, or controller is suspect, this feature can reduce testing time.

XVIII.D.4.b.ix. Display the Error Log:

This selection displays the Error Log. See the Error Logging Menu section in Section **XVIII.C** for complete information.

XVIII.D.4.c. Diskette Drive Error Codes:

The diskette drive error code format is Dd-xx during Certification test, where:

D = Diskette

d = Drive number where:
- 0 = A:
- 1 = B:
- 2 = External

xx = Diskette error code where:
- 01 = Invalid diskette parameter
- 02 = Address mark not found
- 03 = Write-protect error
- 04 = Requested sector not found
- 06 = Diskette change line active
- 08 = DMA overrun on operation
- 09 = Attempted to DMA across a 64K boundary
- 0C = Media type not found
- 10 = Cyclic Redundancy Check (CRC) error on diskette read
- 20 = General controller failure
- 40 = Seek operation failed
- 80 = Diskette drive not ready
- 9E = Data compare error
- 9F = Start test failed
- FF = Sense operation failure

The diskette drive error code format for Error Logging for Certification is #c-Ddxx, where the additional parameters are:

\# = Number of passes

c = Test types -Certification

The diskette drive error code format is cc:hh:ss/Ddtxx, where the additional parameters used for Diagnostic and Error Logging are:

t = Diskette drive specific test where:
- 0 = Certification
- 1 = Start test

3 = Seek/Read
4 = Read Only
5 = Format -Write
6 = Format -Read
7 = Write/Read - Write
8 = Write/Read - Read

cc = Track

hh = Side

ss = Sector

XVIII.D.4.d. Fixed Disk Drive Subsystem

XVIII.D.4.d.i. Overview:

#1-TuffTEST-Pro provides a wide variety of tests and functions designed for the specific technology of each fixed disk interface/type, including ST506/412, ESDI, IDE, and SCSI. **#1-TuffTEST-Pro** thoroughly tests and verifies the controller's circuitry, the drive's mechanical and electrical functions, and the reliability of the fixed disk's surface to retain written data.

The fixed disk drive subsystem physical components include the controller, the drive, and the connectors. One or several of these physical components may be malfunctioning at any one time. These types of problems are referred to as "hard" damage and usually require repair or replacement in a rework facility.

Other problems are referred to as "soft" failures and in many cases can be resolved with a low-level format. Note that in some situations a problem may appear to be a physical one (hard damage) when it is actually a soft failure. These may include a spot failure of the disk surface in a previously good sector, data recording errors due to electrical surges/spikes or improper shut-down activities, or a read/write head mistracking due to mechanical wear or temperature conditions (when the drive is cold or very hot). Also, the drive may appear "dead" due to corruption of the track 0 boot loader information.

The original ST506/412 drives were introduced using the Modified Frequency Modulation (MFM) data encoding methodology. Soon thereafter, the Run Length Limited (RLL) methodology was introduced. RLL encoding increased data density by 50% over MFM. Over time, ST506/412 drives became referred to as either MFM or RLL, depending on the data encoding method being used.

While all fixed disk drives, regardless of type, are capable of using either MFM or RLL encoding, RLL has become the preferred method due to its greater storage capability.

XVIII.D.4.d.ii. Supported Fixed Disk Drive Interfaces/Types:

#1-TuffTEST-Pro supports the following fixed disk drive interfaces/types:

XVIII.D.4.d.ii.a. ST506/412:

The original PC interface, the ST506, was introduced by Seagate Technologies for the XT computers. This was followed by modifications for the AT identified as the ST412, thus this interface is called the ST506/412. This interface is referred to as a "device-level interface" where the computer's BIOS routines direct the limited, or "dumb," controller to perform the head positioning, reads/writes and other functions. All drives of this type are supported.

XVIII.D.4.d.ii.b. Enhanced Small Device Interface (ESDI):

The ESDI interface standard, while an improvement over the ST506/412 type, also had its shortcomings when compared to IDE and SCSI. ESDI saw its greatest success on the earlier Compaq desktop systems and in the early IBM PS/2 products. Support for fixed disk drives of this type is limited by the make and model of host adapter being used. This is due to the lack of standardization in alternate sector mapping, translation modes, controller ID procedures, and device communication modes. The following host adapters (not drives) are currently supported:

- Western Digital 1007 (A and WAH versions)
- Adaptec ACB-232xB
- DTC 6x80

Any ESDI fixed disk drive attached to one of these host adapters can be thoroughly tested using **#1-TuffTEST-Pro**.

NOTE: **#1-TuffTEST-Pro** will not support more than one ESDI fixed disk drive in the same computer.

XVIII.D.4.d.ii.c. Integrated Drive Electronics (IDE):

All drives of this type are supported if their geometries are supported by the system's BIOS.

IBM, with the introduction of the AT, also introduced the AT Attachment (ATA) standard that would allow a wider variety of larger, more capable storage devices to be attached. IDE drives are based on the ATA standard.

The IDE (ATA) interface is referred to as a "logic-level interface." The IDE controller has its own BIOS and localized intelligence and is located within the drive unit. A simple interface bus card performs signal decoding and buffering, the computer's BIOS requests logical functions, and the controller/drive (the "drive") has complete control of the actual drive activity.

It is important to note that the ATA standard defines how functions and data are requested from and received by the computer with no set definition of how it is done within the drive. As such, there is a wide range of storage and retrieval methodology implemented from manufacturer to manufacturer, sometimes within a manufacturer's product line and from the older drives to the newer units.

From a stringent testing point of view, the most important aspect of the IDE interface is its "translation mode" function. The translation mode was incorporated into the IDE specification to ensure downward compatibility for its often unusual drive geometries (a drive's number of heads, cylinders, and sectors per track) to the ST506/412 standard. For example, it is common for an IDE fixed disk drive to have more than 1024 cylinders, and to have more than, or a variable number of, 17 sectors per track. Many BIOS drive-type tables do not directly support these geometries. Therefore, most IDE drives use "logical" values that are translated by the drive's controller into "physical" values.

When an IDE drive is operating in translation mode, it appears to have a BIOS-acceptable geometry. For example, an IDE drive with a physical geometry of 1366 cylinders, 8 heads, and 34 sectors per track, when operating in translation mode, may appear to the computer to have 683 cylinders, 16 heads, and 34 sectors per track.

To successfully perform a low-level format on an IDE fixed disk drive, **#1-TuffTEST-Pro** must communicate with the drive in the mode it is currently operating (logical or physical). **#1-TuffTEST-Pro** obtains its geometry information from the computer's CMOS, which is usually in "logical" format. However, the physical values may be needed on some older drives. If unpredictable results occur on older IDE drives during a Low-Level Format, change the geometry from logical to physical from within the Select Testing Range menu option and try again.

For information regarding a particular fixed disk drive's geometries, contact the manufacturer. Most drive manufacturers will insist that a low-level format cannot be performed on an IDE fixed disk drive, but they will still provide geometry information. **#1-TuffTEST-Pro**, when provided with the proper drive geometry, will successfully format IDE fixed disk drives.

While it may be possible for **#1-TuffTEST-Pro** to perform a low-level format with unusual drive geometries, it may not be usable on the system due to the drive's geometry not being supported by the system's BIOS drive-type table.

XVIII.D.4.d.ii.d. Small Computer Systems Interface (SCSI):

The Small Computer System Interface (SCSI) standard is an intelligent subsystem (not a fixed disk interface) that manages up to eight different devices (fixed disk drives, tape drives, scanners, CD-ROM drives, etc.). The SCSI host adapter (an add-in bus card or components set on the system board) depends on its own internal BIOS and bus, which are separate from that of the host computer. During system power-on process, the SCSI controller queries each device it locates on its bus for the device's operating parameters. These parameters are then used by the controller to operate that device.

#1-TuffTEST-Pro's SCSI tests bypass the system BIOS and work directly with the attached SCSI device using the SCSI command set. This requires a special device driver for each supported host adapter. Therefore, support for fixed disk drives of this type is limited by the make and model of host adapter being used. The following host adapters are currently supported directly:

- Adaptec AHA-1540/1542 (A, B, C, CF) and AHA-1740/1742A (Standard Mode)
- Western Digital WD7000-ASC Host Bus Adapter
- NCR Intelligent SCSI Host Adapter (as found in NCR System 3000 Class 3433 computers)
- NCR SCSI Host Adapter (as found in NCR System 3000 Class 3421 computers)

Any SCSI fixed disk drive or tape drive attached to one of these host adapters can be thoroughly tested using **#1-TuffTEST-Pro**. Selecting these tests for host adapters other than those listed above will produce unpredictable results.

NOTE: Many newer SCSI host adapters, such as Adaptec's AHA-2840/2842A, have configuration and diagnostic utilities in their BIOS ROM. When detected and identified by **#1-TuffTEST-Pro**, these utilities can be accessed via the SCSI Fixed Disk Menu's option: Host Adapter ROM-Based Utilities in Section **XVIII.D.4.d.iv.s**. It is important to note that once program control has been turned over to the host adapter's BIOS ROM, the system usually must be rebooted, which will return to **#1-TuffTEST-Pro**.

XVIII.D.4.d.iii. Hard-Card-Type Fixed Disk Drives:

#1-TuffTEST-Pro does not currently support hard-card-type fixed disk drives due to the nonstandard format used. Consult the manufacturer of the hard card for information regarding proprietary diagnostics for that particular product.

XVIII.D.4.d.iv. Fixed Disk Drive Tests and Functions

XVIII.D.4.d.iv.a. Select Drive to be Tested (ST506/412, ESDI, IDE):

This option must be selected first. If there is only one fixed disk drive installed, it is selected when <Enter> is pressed. If more than one fixed disk drive is installed, the proper drive designator must be entered. The remaining tests will not run unless a fixed disk drive is selected.

ESDI NOTE: Newly installed fixed disk drives using Adaptec ESDI Controllers must first be initialized using the Adaptec-supplied documentation/procedure and using the format programs supplied on the controller's BIOS ROM. The Adaptec controller's BIOS ROM can also be accessed via the DOS DEBUG.COM utility. Until this beginning initialization is done, **#1-TuffTEST-Pro** will display the message, "This drive cannot be tested until it is initialized."

XVIII.D.4.d.iv.b. Select Host Adapter/Drive to be Tested (SCSI):

This option must be selected first. It displays all SCSI host adapters that are supported directly and indirectly (via the Host Adapter ROM-based Utilities option) by **#1-TuffTEST-Pro**. If you select a directly supported host adapter for testing, you will be returned to the SCSI Fixed Disk Menu. If the host adapter is not supported directly, it is indicated on the display and a new selection Host Adapter ROM-based Utilities appears. Selecting this option transfers control to the host adapter's BIOS ROM utilities menu.

If two or more host adapters are installed and recognized by **#1-TuffTEST-Pro**, they must be tested individually by selecting the proper designator. Upon selection, the identification and testing process described above applies to each selection.

XVIII.D.4.d.iv.c. Controller Test (ST506/412, ESDI):

This test verifies operation of the fixed disk drive controller using the controller's ROM-based internal diagnostics. **#1-TuffTEST-Pro** reports the title of each test that the controller is running and displays the result of each test as "PASSED" or "FAILED."

XVIII.D.4.d.iv.d. Controller Test (IDE):

This test verifies operation of the IDE-type fixed disk drive controller circuitry that is an integral component of the fixed disk drive. Therefore, any reported failure indicates that the fixed disk drive's circuitry is malfunctioning and the fixed disk drive needs to be replaced.

XVIII.D.4.d.iv.e. Controller Test (SCSI):

This test verifies operation of the SCSI host adapter independent of the fixed disk drive. Therefore, any reported failure indicates a failing host adapter rather than a failing fixed disk drive.

XVIII.D.4.d.iv.f. Seek (Hysteresis) Test (ST506/412, ESDI, IDE):

This test examines the selected drive's ability to accurately position the heads over each track, from both directions, and at maximum head positioning speed. The test moves the heads from track 1 to the last track (farthest inside near the spindle), track 2 to last, track 3 to last, etc. When reaching the last track, it reverses and goes last track to last track minus 1, then last to last minus 2, etc., until it reaches last track to first track. Any failure is reported in that portion of the display labeled "ERRORS." This test continues until halted by the user. A graphic display shows the progress of the test. If errors are detected, the data should be backed up using a suitable backup utility or application program. A Low-Level Format - UNCONDITIONAL should then be performed, which will reposition the tracks in relation to the heads. The Seek (Hysteresis) Test should then be performed again. If positioning problems are still encountered, the head positioning mechanism needs to be repaired or replaced.

XVIII.D.4.d.iv.g. Find Previously Marked Bad Tracks (ST506/412, ESDI, IDE):

This function reads each track within the selected range to determine if it is currently marked as "bad," either by the manufacturer or a previous low-level format. This is a simple read-and-identify process, with no testing or verification. All tracks previously marked bad are noted in **#1-TuffTEST-Pro's** bad tracks table in Memory. Select Edit and/or Mark Bad Tracks to review the table.

XVIII.D.4.d.iv.h. Surface Analysis (Read and Verify ECC/CRC) Test (ST506/412, ESDI, IDE, SCSI):

The Error Correction Code (ECC) and Cyclic Redundancy Check (CRC) are two types of algorithmic data integrity testing routines used in fixed disk drives. Either technique, but not both, will be used as part of that controller's architecture. When data is written to a sector on the fixed disk drive, the controller automatically performs a mathematical operation on all the data bytes within that sector and records the result of that operation on a portion of the sector immediately following the 512 bytes of data. When data is read from a particular sector, the mathematical operation is again performed and the results compared with the previous results. A graphic display is presented as the test is running in addition to designating the head and cylinder being tested. Any discrepancy between the ECCs/CRCs is reported in the error portion of the display. As this test runs, it logs each defect location and any previously marked bad sectors/tracks into **#1-TuffTEST-Pro's** bad tracks table in memory. Select Edit and/or Mark Bad Tracks to review the table.

If any new errors are detected, the data should be backed up using a suitable application. Then a Low-Level Format function and Media Analysis Test should be performed to restore the drive.

> ESDI NOTE: In using the Surface Analysis Test, if the sector mapping process on the selected fixed disk drive has been changed and a full format has not been performed, the message, "Alternate sector mapping changed -format MUST be run," will be displayed. If a format is required, select Low-Level Format - UNCONDITIONAL.

XVIII.D.4.d.iv.i. Find Optimum Interleave (ST506/412, ESDI):

The interleave factor determines the logical sequence of sector markings, and therefore determines the number of media revolutions necessary for the fixed disk drive to read an entire track. The interleave setting greatly affects the data throughput. If the interleave factor is set too high (more revolutions than necessary), maximum efficiency and speed are not achieved. If the interleave factor is set too low, one complete revolution is required to read each sector. On a drive with 17 sectors per track, the result is the same as an interleave factor of 17 (one sector per revolution). Therefore, it is important that interleave be set properly.

When this test is used, the service cylinder of the fixed disk drive is formatted with interleave factors 8 through 1. The service cylinder is an inner track not used for the storage of data, therefore write/read tests can be performed there. After each interleave factor is written, that cylinder's data is read, the process timed in bytes per second, and the calculated read time is written to the display. Upon completion of this process, **#1-TuffTEST-Pro** indicates the optimum interleave factor on the display. This interleave factor should then be entered within the format portion of **#1-TuffTEST-Pro** and the fixed disk drive should be reformatted with the optimum interleave factor.

It is important to note that the interleave factor is determined based on the retrieval of sequential data, meaning that the data to be read is available in adjacent sectors. If the primary application of the drive being formatted is one that accesses fragmented data or not sequentially, i.e., randomly, optimum interleave performance may be achieved by increasing the interleave factor by 1.

XVIII.D.4.d.iv.j. Low-Level Format - CONDITIONAL (Preserve Bad Tracks) (ST506/412, ESDI, IDE):

CAUTION!! SELECTION OF THIS OPTION WILL DESTROY ALL DATA ON THE SELECTED FIXED DISK DRIVE.

This test overwrites all existing data and sector/cylinder address marks. New address marks and data blocks are written. Bad track entries from previous formatting processes are left intact. If it is desired to delete previous bad tracks entries, use the Low-Level Format - UNCONDITIONAL selection.

With some fixed disk drive controllers, the routines used to preserve bad tracks markers cause recalibration seeks to track 0 after each track is formatted. These recalibration seeks significantly increase the time required to format. When this is the case, the following alternate method is suggested:

1) Use the Find Previously Marked Bad Tracks function to locate and log all existing bad tracks flags to **#1-TuffTEST-Pro's** bad tracks table in memory.

2) Select Low-Level Format -UNCONDITIONAL to perform a timely format of the fixed disk.

3) Select Media Analysis Test to locate and log newly identified bad tracks to the bad tracks table in memory.

4) Select Edit and/or Mark Bad Tracks to review and mark all tracks indicated in the bad tracks table in memory.

The fixed disk drive is now ready for an operating system partition and format.

IDE NOTE: If unpredictable results occur during the low-level format of an IDE fixed disk drive, change the geometry (from translated to physical) from within Select Testing Range and try again.

IDE NOTE: The ATA standard was developed by the fixed disk drive manufacturers to overcome IDE, BIOS and operating system limitations on drives over 540 MB. Unfortunately, the low-level format command was made "optional" under this standard and not all manufacturers have chosen to support it for ALL the models they produce. The Media Analysis Test works on all drives and is a good substitute because it writes/reads/verifies to every sector on the drive including the boot sector.

ESDI NOTE: For ESDI-type drives, the Low-Level Format - CONDITIONAL function does not support Alternate Sector Mapping. If the currently selected fixed disk drive is using alternate sector mapping, the message, "This option is not available with this drive or controller," will be displayed. If a format is required, select Low-Level Format - UNCONDITIONAL.

XVIII.D.4.d.iv.k. Low-Level Format - UNCONDITIONAL (ST506/412, ESDI, IDE):

CAUTION!! SELECTION OF THIS OPTION WILL DESTROY ALL DATA ON THE SELECTED FIXED DISK DRIVE.

This test overwrites all existing data and sector/cylinder address marks with new address marks and data blocks. Bad track entries from previous formatting processes are overwritten.

As fixed disk drives wear, the relative track positions can change. When this happens, the

relative location of defects will also change. In these circumstances, if previous bad track entries are not cleared, the old bad track locations will still be marked bad, even though the defect has moved and the location now contains reliable media.

In addition, this option must be used if the drive will no longer boot because the track 0 boot loader information has become corrupted.

IDE NOTE: If unpredictable results occur during the low-level format of an IDE fixed disk drive, change the geometry (from translated to physical) from within Select Testing Range and try again.

IDE NOTE: The ATA standard was developed by the fixed disk drive manufacturers to overcome IDE, BIOS and operating system limitations on drives over 540 MB. Unfortunately, the low-level format command was made "optional" under this standard and not all manufacturers have chosen to support it for ALL the models they produce. The Media Analysis Test works on all drives and is a good substitute because it writes/reads/verifies to every sector on the drive including the boot sector.

ESDI NOTE: For ESDI-type drives, the Low-Level Format - UNCONDITIONAL function determines whether alternate sector mapping is currently enabled or disabled on the selected fixed disk drive. A message will be displayed indicating the fixed disk drive's current sector mapping selection, followed by the message: "Do you want to use alternate sector mapping (Y/N)?" Input the desired Y/N selection. If the sector mapping process on the selected fixed disk drive is changed, a full format is required.

XVIII.D.4.d.iv.l. Low-Level Format (SCSI):

CAUTION!! SELECTION OF THIS OPTION WILL DESTROY ALL DATA ON THE SELECTED FIXED DISK DRIVE.

On SCSI-type drives, this test rewrites all existing data and sector/cylinder address marks. New address marks and data blocks are written. Bad block entries from previous formatting processes are left unchanged. No defect data is used for this process. If media defects are suspected, use Surface Analysis Test or Media Analysis Test to locate defects, then perform the Reassign Blocks function.

XVIII.D.4.d.iv.m. Media Analysis (Write/Read) Test (ST506/412, ESDI, IDE, SCSI):

CAUTION!! SELECTION OF THIS OPTION WILL DESTROY ALL DATA ON THE SELECTED FIXED DISK DRIVE.

The Media Analysis Test is **#1-TuffTEST-Pro's** most thorough media test. For best results, it should be run in continuous mode for at least 2-5 passes. This test writes seven different high-stress data patterns, calculates and enters the appropriate CRC (the cyclic redundancy check character) for each pattern, reads the data back, recalculates the CRC, and compares both CRC results in the selected test range. A graphic display is presented as the test is running in addition to designating the head and cylinder being tested. Any discrepancy between CRCs is reported in the error portion of the display.

As this test runs, it logs each defect location into **#1-TuffTEST-Pro's** bad track table in memory.

Select Edit and/or Mark Bad Tracks to review the table. It is important to note that defects can be affected by bad or improperly placed format information. A Media Analysis Test should only be performed as a final step AFTER a Low-Level Format - CONDITIONAL or a Low-Level Format - UNCONDITIONAL. Only this defect information, combined with manufacturer-supplied defect maps, should be used to update the bad track table on the fixed disk using the Edit and/or Mark Bad Track function.

NOTE: It is possible to run this test without destroying existing data if the service cylinder is isolated using Select Testing Range.

ESDI NOTE: In using the Media Analysis Test, if the sector mapping process on the selected fixed disk drive has been changed and a full format has not been performed, the message, "Alternate sector mapping changed format MUST be run," will be displayed. If a format is required, select Low-Level Format - UNCONDITIONAL.

XVIII.D.4.d.iv.n. Edit and/or Mark Bad Tracks (ST506/412, ESDI, IDE):

This function allows the user to view, add, delete, and/or edit entries in **#1-TuffTEST-Pro's** Bad Track Table in memory. Bad track locations are automatically logged here by Find Previously Marked Bad Tracks, Surface Analysis, and Media Analysis. Additionally, manufacturer-supplied defect/bad track parameters, which may be found as an external label on the drive's housing, can be entered here.

Finally, when requested by the user, this function writes bad track markers to all indicated sectors/tracks on the fixed disk drive. The actual locking out of bad tracks from the file allocation table is a function of the operating system (high-level) format.

XVIII.D.4.d.iv.o. Reassign Blocks (SCSI):

This function takes the blocks found to be bad as a result of using Surface Analysis or Media Analysis, and deactivates and reassigns them via the SCSI host adapter.

XVIII.D.4.d.iv.p. Select Testing Range (ST506/412, ESDI, IDE):

This function allows user selection of a particular portion of the fixed disk drive media for testing. This is often advantageous, as most fixed disk drive tests take a considerable amount of time. If a particular portion of the fixed disk drive media is suspect, this feature dramatically decreases testing time.

Additionally, this function is used to isolate the service cylinder, allowing the execution of destructive tests without destroying existing data. The service cylinder is an inner track not used for storage of data, therefore write/read tests can be performed there. To isolate the service cylinder:

SCSI NOTE: This function is not available for the SCSI Low-Level Format function as the entire drive is automatically formatted.

For ST506/412, ESDI, IDE:

1) From the entry level Fixed Disk Drive Menu: select Select Testing Range.

2) At the prompt Enter starting cylinder number: enter the number displayed as the ending cylinder number and press <Enter>.

3) At the prompt Enter ending cylinder number: press <Enter>.

4) At the prompt Enter starting head number: enter the number 0.

5) At the prompt Enter ending head number: enter the number displayed as the highest head number.

For SCSI:

1) From the entry level Fixed Disk Menu: choose Select Testing Range.

2) At the prompt Enter starting block number: enter the number displayed as the ending cylinder number and press <Enter>.

3) At the prompt Enter ending block number: press <Enter>.

XVIII.D.4.d.iv.q. Display Error Log (ST506/412, ESDI, IDE, SCSI):

This selection displays the Error Log. See the Error Logging Menu section in Section **XVIII.C** for complete information.

XVIII.D.4.d.iv.r. Park the Disk Heads (ST506/412, ESDI, IDE):

This utility function moves the write/read heads of the selected fixed disk drive to the service cylinder. The purpose of this function is to move the heads away from any data. This function should be invoked before removal and/or shipping of any fixed disk drive.

XVIII.D.4.d.iv.s. Host Adapter ROM-Based Utilities (SCSI):

Many newer SCSI host adapters, such as Adaptec's AHA-2840/2842A, have configuration and diagnostic utilities in their ROM BIOS. When detected and identified by **#1-TuffTEST-Pro**, these utilities can be accessed via this menu selection. Be careful not to change any of the configuration settings unless you intend to. Functions such as low-level format and surface scan can usually be found under the disk utility menu selection. It is important to note that once program control has been turned over to the host adapter's BIOS ROM, the system usually must be rebooted, which will return you to **#1-TuffTEST-Pro**.

XVIII.D.4.e. Low-Level Formatting

XVIII.D.4.e.i. Overview:

REMEMBER THAT LOW-LEVEL FORMATTING IS DESTRUCTIVE BECAUSE IT WRITES ACROSS THE ENTIRE DRIVE, SO FIRST BACK UP THE DATA, IF POSSIBLE.

Low-level formatting writes the track header/identification information at the start of each track, then within that track each sector header/ID, sector data area, sector trailer, and intersector gaps. The actual formatting activity is somewhat different based on the controller/drive type, but the end result is the same.

After low-level formatting, partitioning and high-level formatting is done by the operating system. The operating system's file management system identifies the tracks marked good or bad on the drive by the low-level format, and then creates a table or file of these addresses for subsequent use in allocating disk space to files as requested by application programs.

#1-TuffTEST-Pro provides two functions, Low-Level Format - CONDITIONAL and Low-Level Format - UNCONDITIONAL for ST506/412, ESDI, and IDE. There is only one function for SCSI, Low-Level Format, which is under the control of the SCSI host adapter.

The Low-Level Format - CONDITIONAL function, reads the tracks and when it encounters a sector that is marked bad, either from the factory or a previous low-level format,it does not test it or write new format information. It merely bypasses that sector and goes on to the next one. Under some soft failure situations, a conditional format may be appropriate because it retains all sectors previously marked "bad." However, in many cases, this formatting technique will not resolve the drive's problems as it does not deal with any track 0 problems or rewrite any previously bad sectors that may have erroneously been marked bad or that may now be mistracking. If track 0 is corrupted and the drive will no longer boot, you must use Low-Level Format - UNCONDITIONAL to repair the drive.

The Low-Level Format - UNCONDITIONAL function resets the entire drive from track 0 to the spindle. Generally, the technical event during formatting is to write 00 hexadecimal(h) to the sector header to mark it "good" and an 80h to mark it bad. To mark a track bad, all sectors would be marked with an 80h. The unconditional low-level format writes 00h to all sectors in all tracks, regardless of their previous markings/status.

Upon completion of a successful low-level format, the drive is ready for a sector-by-sector analysis of the drive's surface via the Surface Analysis Test and/or Media Analysis Test.

XVIII.D.4.e.ii. Suggested Low-Level Formatting Procedure:

**** ALWAYS, FIRST BACK UP THE DRIVE'S DATA -- IF POSSIBLE ****

For ST506/412, ESDI, and IDE:

1) Perform the Seek (Hysteresis) Test for 15 to 20 minutes to allow the drive's components and materials to expand or otherwise change in response to the operational temperature.

2) On ST506/412 and ESDI drives only, determine the optimum interleave factor using Find Optimum Interleave. This will determine the optimum sector organization to be used in the format process.

3) Use the Find Previously Marked Bad Tracks function to identify and log all tracks that were previously marked as bad to **#1-TuffTEST-Pro's** bad tracks table in memory.

4) Select the Edit and/or Mark Bad Tracks function to review the results of Step 3.

5) Remove the cover and check the fixed disk drive for an external label on the drive housing indicating the manufacturer's defect/bad track list (usually in cylinder, head, and bytes from index--BFI--notation). Make a written list of these areas for later use. Note that most newer drives may not have this label.

6) Perform a Low-Level Format - UNCONDITIONAL to create new tracks and sectors across the entire drive surface.

7) Next perform a Media Analysis Test to locate and mark all bad tracks to the bad tracks table in memory.

8) Select the Edit and/or Mark Bad Tracks function to review the bad tracks found in step 7. Newly found bad tracks will be marked with an asterisk (*).

9) Compare the new bad tracks found in step 7 and the previously marked bad tracks found in step 3 with the manufacturer's label (if any) from step 5. Enter, via the Edit and/or Mark Bad Tracks function, all bad tracks not found in steps 3 and 7.

   NOTE: A determination needs to be made as to whether the number of defects are acceptable. A standard that is often used is that the number of defects should not exceed one hard error per megabyte of disk space. This can be translated to a worst-case example where up to 512 defective bytes per megabyte of disk space (or .05%) is acceptable.

10) Finally, via the Edit and/or Mark Bad Tracks function, mark the bad tracks on the fixed disk drive.

The drive is now ready for operating system partitioning and high-level formatting.

For SCSI:

1) Perform a Surface Analysis Test for 15 to 20 minutes to allow the drive's components to expand or otherwise change in response to the operational temperature.

2) Perform the Low-Level Format function.

3) Perform the Media Analysis Test to locate prior and new bad blocks.

4) Perform the Reassign Blocks function.

The drive is now ready for operating system partitioning and high-level formatting.

XVIII.D.4.f. SCSI Tape Drive Tests:

This grouping of SCSI tests bypasses the system BIOS and works directly with the attached SCSI device using the SCSI command set. A special device driver is required for each supported host adapter. Therefore, support for tape drives of this type is limited only by the make and model of

host adapter being used. The following host adapters are directly supported:

- Adaptec AHA-1540/1542 (A, B, C, CF), and AHA-1740/1742A (Standard Mode)
- Western Digital WD7000-ASC
- NCR Intelligent SCSI Host Adapter (as found in NCR System 3000 Class 3433 computers)
- NCR SCSI Host Adapter (as found in NCR System 3000 Class 3421 computers)

Any SCSI tape drive attached to one of these host adapters can be thoroughly tested using **#1-TuffTEST-Pro**. Selecting these tests for host adapters other than those listed above will produce unpredictable results.

XVIII.D.4.f.i. Select Drive to be Tested:

This option must be selected first. If there is only one tape drive installed, it is selected when <Enter> is pressed. If more than one tape drive is installed, the proper drive designator must be entered. The remaining tests will not run unless a drive is selected.

NOTE: A blank tape cartridge must be properly inserted in the tape drive BEFORE the drive is selected.

XVIII.D.4.f.ii. Combination Test:

This test executes all of the SCSI tests listed below.

XVIII.D.4.f.iii. Erase Test:

This test determines if the erase function of the tape drive is working properly. The tape is first rewound and checked for errors. The entire tape is then erased and again checked for errors. All errors are reported in the error portion of the display.

XVIII.D.4.f.iv. Retension Test:

This test determines if the retension function of the tape drive is working properly. The tape is first rewound and checked for errors. The tape is then retensioned and checked for errors. All errors are reported in the error portion of the display.

XVIII.D.4.f.v. Write Filemarks Test:

This test determines the ability of the tape drive to write and read filemarks. The tape is first rewound and checked for errors. Then 512 consecutive filemarks are written to the tape and checked for errors. The tape is again rewound and checked for errors. Finally, the tape is

spaced past 512 consecutive filemarks and again checked for errors. All errors are reported in the error portion of the display.

XVIII.D.4.f.vi. Start/Stop/Write Test:

This is a high-stress test that exercises the tape drive's ability to start, stop, read, and write. The tape is first rewound and checked for errors. Then 1024 blocks of data are written, forcing the tape to stop, rewind, and verify after each block. The tape is again rewound and checked for errors. All 1024 blocks of data are then sequentially verified and checked for errors. All errors are reported in the error portion of the display.

XVIII.D.4.f.vii. Short-Streaming Write Test:

This is a quick check of the tape drive's ability to write data in a streaming mode. The tape is first rewound and checked for errors. Then, while the status is continually monitored, 256 32-block writes are performed. The tape is again rewound and checked for errors. All 8192 blocks are then verified and checked for errors. All errors are reported in the error portion of the display.

XVIII.D.4.f.viii. Long-Streaming Write Test:

This is a long test of the tape drive's ability to write data in a streaming mode. The tape is first rewound and checked for errors. Then, while the status is continually monitored, 32-block writes are performed over the entire tape. The tape is again rewound and checked for errors. The entire tape is then verified and checked for errors. All errors are reported in the error portion of the display.

XVIII.D.4.f.ix. Display Error Log:

This selection displays the Error Log. See the Error Logging Menu section in Section **XVIII.C** for complete information.

XIV.D.4.g. Fixed Disk Drive and Tape Drive Error Codes

XIV.D.4.g.i. ST506/412, ESDI, IDE (Fixed Disk Drives Only):

The fixed disk drive error code format for Certification and Diagnostics for ST506/412, and IDE drives is Fd-xx where:

F = Fixed disk

d = Drive number

xx = BIOS Error code where:

01	=	Invalid function request - bad command
02	=	Address mark not found
03	=	Write-protect error
04	=	Sector not found
05	=	Reset failed
07	=	Drive parameter activity failed
08	=	DMA overrun on operation
09	=	Data boundary error -DMA boundary error
0A	=	Bad sector flag detected - bad sector (marked bad)
0B	=	Bad cylinder detected - bad track
0D	=	Invalid number of sectors in format
0E	=	Control data address mark detected
0F	=	DMA arbitration level out of range
10	=	Uncorrectable Error Checking and Correction (ECC) error.
11	=	ECC corrected data error (ECC error that was corrected)
20	=	General controller failure
40	=	Seek operation failed
80	=	Time-out, no response from device
9E	=	Data compare error
AA	=	Drive not ready
BB	=	Undefined error occurred
CC	=	Write fault on selected drive
E0	=	Status error/error register=0 unknown status error
FF	=	Sense operation failed

The fixed disk drive error code format for Error Logging for ST506/412, ESDI, and IDE drive types is ccc:hh:ss/Fdtxx where the additional parameters are:

t = Test number where:

1	=	Seek (Hysteresis)
2	=	Media Analysis
3	=	Surface Analysis
4	=	Low-Level Format - Test CONDITIONAL
5	=	Low-Level Format - Test UNCONDITIONAL
6	=	Park Heads Test

xx = See above

hh = Head number

ccc = Cylinder number

ss = Sector number

XVIII.D.4.g.ii. SCSI (Fixed Disk and Tape Drives)

XVIII.D.4.g.ii.a. ADAPTEC/NCR:

The error code for Adaptec/NCR SCSI drive types is DTLt-ABS, where:

D = Device where:
- A = Tape Drive
- F = Fixed Disk

T = Target

L = LUN (Logical Unit Number)

t = Test Number where:

If Fixed Disk
- 0 = Controller
- 1 = Media Analysis
- 2 = Surface Analysis
- 3 = Reassign Blocks
- 4 = Format Disk

If Tape
- 1 = Combination
- 2 = Erase
- 3 = Retension
- 4 = Write Filemarks
- 5 = Start/Stop Write
- 6 = Short-Streaming Write
- 7 = Long-Streaming Write

A = Adapter Error Code where:
- 00 = No host adapter detected
- 0A = Linked command complete without error
- 0B = Linked command complete without error, interrupt generated
- 11 = Selection time out
- 12 = Data overrun/underrun
- 13 = Unexpected bus free
- 14 = Target bus phase sequence failure
- 15 = MBO (Mail Box Out) command was not 00, 01, or 02
- 16 = First byte of the CCB (Command Control Block) was not 00, 01, 02, or 81
- 17 = Linked CCB does not have the same status byte codes
- 18 = Invalid CCB parameter received from host in target mode
- 19 = Duplicate CCB received in target mode
- 20 = Linking violation in target mode

B = Target Status:
- 00 = Good status
- 02 = Check status
- 08 = LUN busy
- 18 = Reservation conflict

S = Sense Key:
- 0 = No Sense

1 = Recovered Error
2 = Not Ready
3 = Media Error
4 = Hardware Error
5 = Illegal Request
6 = Unit Attention
7 = Data Protect
8 = Blank Check
9 = Vendor Unique
A = Copy Aborted
B = Aborted Command
C = Equal
D = Volume Overflow
E = Miscompare
F = Reserved

XVIII.D.4.g.ii.b. Western Digital 7000:

The error code for the Western Digital 7000 SCSI device types is DTLt-ABS where:

D = Device where:
- A = Tape Drive
- F = Fixed Disk

T = Target

L = LUN (Logical Unit Number)

t = Test Number where:

If Fixed Disk
- 0 = Controller
- 1 = Media Analysis
- 2 = Surface Analysis
- 3 = Reassign Blocks
- 4 = Format Disk

If Tape
- 1 = Combination
- 2 = Erase
- 3 = Retension
- 4 = Write Filemarks
- 5 = Start/Stop/Write
- 6 = Short-Streaming Write
- 7 = Long-Streaming Write

A = Adapter Error
- 00 = Power-up condition
- 01 = No errors occurred
- 02 = RAM failed
- 03 = FIFO (first-in first-out) buffer Read/Write failure
- 04 = SBIC (SCSI Bus Interface Controller) failure
- 05 = Initialization D-FF (D Flip-Flop Register) failure
- 06 = Host IRQ D-FF failure

07	=	ROM checksum error
08	=	Unexpected SBIC response during data out phase
09	=	Unexpected SBIC response during data in phase
0A	=	Unexpected SBIC response during command out phase
0B	=	Unexpected SBIC response during status in phase
0C	=	Unspecified SCSI out phase
0D	=	Unspecified SCSI in phase
0E	=	Unexpected SBIC response during message out phase
0F	=	Unexpected SBIC response during message in phase
10	=	Unexpected SBIC interrupt status code
18	=	DMA (Direct Memory Access) error during host system memory diagnostics
20	=	Command issued with OGMB (Outgoing Mail Box) marked empty
21	=	Illegal command parameter
22	=	Command cannot be executed at the present time
23	=	Target data direction contrary to the one specified
24	=	Set/read execution parameters index out of range
25	=	Set/read execution parameters count out of range
26	=	Host has a previous command in progress for the same SCSI target and LUN
40	=	Target sent less data than the allocation length (bytes 16 -18)
41	=	Target wants to send more data than the allocation length
42	=	Target wants to transfer data but host allocation length = 0
43	=	Reserved
44	=	Specified tag (SCSI ID+LUN)command aborted
45	=	Specified target received reset message - command aborted
4D	=	Timeout occurred during target selection/reselection
4E	=	Target did not send ID message, or invalid source ID
4F	=	No record of the SCB (SCSI Command Execution Block) to be executed
50	=	Unrecoverable error or disconnect in ID or selection phase
51	=	Unrecoverable error or disconnect in command phase
52	=	Unrecoverable error or disconnect in message in phase
53	=	Unrecoverable error or disconnect in message out phase
54	=	Unrecoverable error or disconnect in ID or reselection phase
55	=	Unrecoverable error or disconnect in data transfer phase
56	=	Unrecoverable error or disconnect in status phase
57	=	Unrecoverable error or disconnect in command phase
80	=	SCSI hard reset during a solicited selection
81	=	valid command bytes in scratchpad buffer
82	=	No command scratchpad buffer opened
83	=	Illegal CDB (Command Data Block) transfer length

84 = No inbound data buffer opened, wrong ID, or unqualified LUN
85 = No sense data buffer opened for the specified LUN
86 = Buffer opened but next command was not request sense
87 = No inquiry buffer opened as qualified by LAV/IAV (LUN Acceptance Vector/ID Acceptance Vector)
88 = No outbound data buffer opened, wrong ID, or unqualified LUN
FF = Not applicable in current field

B = Target Status where:
00 = Reserved
01 = Command complete, no errors
02 = Command complete, error logged in SCB/ICB(SCSI Command Execution Block/Interface Command Block) bytes 14 and 15
03 = Scan OGMB (Out-Going Mail Box) command has been completed
04 = Command failed to complete without SCSI status
05 = Command terminated, bus reset by external device during SCB
06 = SBIC or hardware failure, requires host reset
07 = SCSI soft reset command completed
08 = Link command complete with no errors when flag bit is set
80 = Unexpected reselection
81 = Unexpected selection
82 = Abort command message
83 = SCSI reset message received
84 = SCSI hardware reset with no command in queue

S = Sense Key
0 = No Sense
1 = Recovered Error
2 = Not Ready
3 = Media Error
4 = Hardware Error
5 = Illegal Request
6 = Unit Attention
7 = Data Protect
8 = Blank Check
9 = Vendor Unique
A = Copy Aborted
B = Aborted Command
C = Equal
D = Volume Overflow
E = Miscompare
F = Reserved

XVIII.D.5.a. Overview:

#1-TuffTEST-Pro provides extensive testing for all standard serial (asynchronous/RS-232) communication interfaces (COM1, COM2, COM3, and COM4 ports) at the standard addresses, both internally and externally.

In addition to the standard interfaces (ports), **#1-TuffTEST-Pro** also tests up to 64 User-Defined Addresses (UDA) for interfaces (ports) installed at addresses other than the standard addresses. All multiport I/O boards and other nonstandard address interfaces can be tested if they comply with the industry standard asynchronous (RS-232) communications protocol.

XVIII.D.5.b. Serial Interface Architecture:

The serial interface is designed for two-way communication. It can send data or reverse the process and receive data in exactly the same fashion with its full range of capability.

Data, in the form of 8-bit bytes, is sent over the bus in parallel form to the port. The asynchronous interface board at the port address takes the parallel data in and converts it to serial format by "clocking" it out of its buffer at set intervals (baud rate) in a serial fashion. The interface board conditions the signals for transmission and sends them out through the interface connector either remotely (via modem) or locally (via cabling). This parallel-to-serial conversion when transmitting and serial-to-parallel conversion when receiving is the primary function of the serial interface.

The primary component of the serial interface is either a Universal Asynchronous Receiver Transmitter (UART), or Universal Synchronous/Asynchronous Receiver Transmitter (USART) integrated circuit module (chip).

All of the data flows through two lines (wires--as in the "twisted" pair telephone line), with one line for signals going out and one line for signals coming in. This is known as "full duplex" communication.

The lines carry data, control, and status signals in both directions. Data and control go out and the status comes back in. This can be reversed where data and control comes in and status is sent out. The interface can create each type of signal for transmission, or identify and verify them when receiving. To do this the interface (printed circuit board that goes into a bus slot) has buffers and registers for data, control, and status functions. As they are an integral part of the UART/USART design, they can be tested both internally and externally. The external testing also includes the line driver/signal conditioning components and circuits that work with the external connector (either a male-type DB-25 or DB-9).

If all of the **#1-TuffTEST-Pro** tests pass and do not indicate a malfunction on the interface adapter board, check the cabling or the serial device at the other end of the cable.

XVIII.D.5.c. Serial Interface Testing

XVIII.D.5.c.i. Select I/O Port Addresses:

To perform either the internal or external tests, the address(es) must first be specified. This selection displays the four standard COM ports and their addresses and 64 additional User-Defined Addresses (UDA).

Each standard BIOS-supported port that is found by **#1-TuffTEST-Pro** will be identified as installed by a "+" mark after the address (e.g., 03F8+). It can be toggled ON/OFF for testing by pressing the "T" key. The default setting is ON. Ports that have been toggled ON for testing will be marked with an "*" before the address (e.g., *03F8+).

> NOTE: A port may be installed at a standard address, but if it is not indicated as installed nd BIOS-supported by **#1-TuffTEST-Pro**, it would appear to be malfunctioning. To verify the port, the address can be toggled ON and the interface can be tested.

Each standard UDA can also be toggled ON/OFF for testing with the default setting as OFF. The UDAs start at 0100h address (the accepted convention for additional interfaces) and increment by 8 bytes up to 64 addresses. Note that the address range of 0200-03FF is not included in **#1-TuffTEST-Pro's** standard display. These addresses are often used for attaching devices other than serial interfaces. If the system has a serial interface installed at an address in this range, or any other address not listed, it can be entered as a UDA and tested.

Navigating via the arrow keys, place the cursor at any UDA listed on the display, press the space bar, and enter the 4-digit hexadecimal address to be tested. The entered address will appear at the location of the cursor (the prior UDA). All user-entered addresses can be toggled ON/OFF for testing.

The following tests can be performed on all addresses selected (toggled ON):

XVIII.D.5.c.ii. Internal Operations Test:

The UART/USART is switched into the test mode, enabling **#1-TuffTEST-Pro** to test its internal registers without transmitting data to the external interface. While in this mode, data is written in parallel format to the UART/USART which converts it to serial data and adds the control (handshake) status signals. It is transmitted internally within the UART/USART, which loops it back internally, checks the control line (handshake) status signals, then reconverts it to parallel data. The reconverted data is then read and compared by **#1-TuffTEST-Pro**. Any failure is reported as "FAILED" and is displayed next to the failing transmission signal(s).

XVIII.D.5.c.iii. External Operation Test:

This test requires the DB-25 Serial TEST Plug (the yellow plug if purchased from *#1-PC Diagnostics Company*) and/or the DB-9 Serial TEST Plug (the green plug if purchased from *#1-PC Diagnostics Company*) to be inserted into the DB-25 and/or DB-9 connector on the back of the serial adapter(s). During this test, **#1-TuffTEST-Pro** performs the transmission portion of the internal test with the test mode turned off. This causes the UART/USART to send data out via the interface connector and receive it back after it is looped through the external TEST Plug which is installed in the interface connector. It also sends and receives the control line (handshake) status signals. **#1-TuffTEST-Pro** then reads the Modem Status Register in the

UART/USART and displays an error code if the expected values of the status bits are not correct. Any failure is reported as "FAILED" and displayed next to the failing transmission signal(s).

XVIII.D.5.c.iv. Display Error Log:

This selection displays the Error Log. See the Error Logging Menu section in Section **XVIII.C** for complete information.

XVIII.D.5.d. Serial Interface Error Codes:

Serial (Asynchronous) Interface error code format is Stxx-aaaa where:

S = Asynchronous (Serial) error

t = Test number where:
- 1 = Transmitter test
- 2 = Receiver test
- 3 = Data test
- 4 = External Control Line test
- 5 = Internal Control Line test

xx = Bits that failed where:
- x = Value of 1st x
- x = Value of 2nd x

aaaa = The address, in hex, of the port that failed

The "xx" portion indicates either a status code or an error code, depending on the test. Each "x" is expanded into 4 bits via the Serial Interface Error Bit Chart in Section **XVIII.D.5.e**. Equate the "FAILED" bits to the status or error code explanation chart for each test below.

The "xx" portion of the error codes generated by the various tests (the error code "t" value) are as follows:

XVIII.D.5.d.i. Transmitter Test or Receiver Test:

(Error code "t" = 1 or 2) Reports the status of the UART/USART internal circuitry. Bit 7 is not used. Where xx = 01 indicates that bit position 0 (oooo oooF) failed the test, and an error code of FF (FFFF FFFF) would indicate that ALL bits failed the test.

	1st 'x'				2nd 'x'			
Bits	7	6	5	4	3	2	1	0
	|	|	|	|	|	|	|	|
	|	|	|	|	|	|	|	DATA READY flag
	|	|	|	|	|	|	OVERRUN error	
	|	|	|	|	|	PARITY error		
	|	|	|	|	FRAMING error			

```
                    |  |  |  |
                    |  |  |  BREAK INTERRUPT detected
                    |  |  TRANSMITTER EMPTY
                    |  TRANSMITTER SHIFT REGISTER EMPTY
                   not used
```

For example, an error code where the "xx" portion is 02 (oooo ooFo) indicates that bit 1 (OVERRUN error) failed.

XVIII.D.5.d.ii. <u>Data Test:</u>

(Error code "t" = 3) The error code indicates the data bit(s) in the internal circuitry that failed. Where xx = 01 indicates that bit position 0 (oooo oooF) failed the test, and an error code of FF (FFFF FFFF) would indicate that ALL bits failed the test.

```
                    1st 'x'          2nd 'x'

Bits          7  6  5  4        3  2  1  0
```

For example, an error code where the "xx" portion is 96 (FooF oFFo) indicates that bits 7, 4, 2, and 1 failed.

NOTE: Refer to the Serial Interface Error Bit Chart in Section **XVIII.D.5.e** for the error code values.

XVIII.D.5.d.iii. <u>External/Internal Control Line Tests:</u>

(Error code "t" = 4 or 5) Report the status of the looped-back signal by reading the modem status register. Bits 4-7 are not used. Where xx = 01 indicates that bit position 0 (oooo oooF) failed the test, and an error code of FF (FFFF FFFF) would indicate that ALL bits failed the test.

```
                    1st 'x'          2nd 'x'

Bits          7  6  5  4        3  2  1  0
                |_____|        |  |  |  |
                   |           |  |  |  CLEAR TO SEND (CTS) signal
               Not Used        |  |  DATA SET READY (DSR) signal
                               |  RING INDICATOR (RI) signal
                              RECEIVER SIGNAL DETECTED (CD) signal
```

For example, an error code where the "xx" portion is 04 (oooo oFoo) indicates that bit 2 (RING INDICATOR signal) failed.

NOTE: Refer to the Serial Interface Error Bit Chart in Section **XVIII.D.5.e** for the error code values.

NOTE: This test requires that the appropriate Serial Interface TEST Plug be connected to the interface being tested. If the TEST Plug is not installed, all of the tests will fail (xx = oF).

XVIII.D.5.e. Serial Interface Error Bit Chart:

	BIT POSITION					BIT POSITION				
	7	6	5	4		3	2	1	0
Value of:	1st "x"				2nd "x"					
	0 =	o	o	o	o	0 =	o	o	o	o
	1 =	o	o	o	F	1 =	o	o	o	F
	2 =	o	o	F	o	2 =	o	o	F	o
	3 =	o	o	F	F	3 =	o	o	F	F
	4 =	o	F	o	o	4 =	o	F	o	o
	5 =	o	F	o	F	5 =	o	F	o	F
	6 =	o	F	F	o	6 =	o	F	F	o
	7 =	o	F	F	F	7 =	o	F	F	F
	8 =	F	o	o	o	8 =	F	o	o	o
	9 =	F	o	o	F	9 =	F	o	o	F
	A =	F	o	F	o	A =	F	o	F	o
	B =	F	o	F	F	B =	F	o	F	F
	C =	F	F	o	o	C =	F	F	o	o
	D =	F	F	o	F	D =	F	F	o	F
	E =	F	F	F	o	E =	F	F	F	o
	F =	F	F	F	F	F =	F	F	F	F

o = passing (ok), or OFF status
F = failing, or ON status

For example, an "xx" error code of 02 would have the value of oooo ooFo and would indicate that bit 1 was failing. An "xx" error code of 4A would be oFoo FoFo, indicating bits 6, 3, and 1 were failing.

XVIII.D.6. Memory Menu <Diagnostic Menu F7>

XVIII.D.6.a. Overview:

#1-TuffTEST-Pro's memory tests are divided into three areas: Main Memory, Extended Memory, and Expanded Memory. The Main Memory tests appear on all computers and relate to the first 640K of memory. The Extended Memory tests were introduced with the IBM PC AT-level systems (80286) and exist on all subsequent systems. The Expanded Memory tests were also introduced on the IBM PC AT and usually involve an add-in board with additional memory that resides outside the standard memory map and is accessed through address-swapping techniques.

This memory testing documentation is arranged to show the common tests that appear in Main Memory, Extended Memory, and Expanded Memory, with any unique memory testing information

indicated in the appropriate sections that follow for each type of memory.

There are many personal computer brands, makes, and models in the marketplace today, all having their "unique" system board layout, and in some cases, BIOS modifications. This **#1-TuffTEST-Pro** User Handbook is designed to identify the memory modules that are failing based on industry standard systems and provide a general set of rules that assist in identifying the failing module from the error code for systems that deviate from the standard systems.

As PC architecture evolved, so have memory modules. In the earlier PC, XT, AT types of PCs, memory modules were the Dual Inline Package (DIP) type, the classic memory "chips." With the introduction of PS/2, 80386, i486, Pentium, Pentium Pro, and Pentium II PCs, newer memory designs were used, including Single Inline Pin Package (SIPP), Single Inline Memory Module (SIMM), and more recently the Dual Inline Memory Module (DIMM). **#1-TuffTEST-Pro** tests memory by address through the PC's CPU and can be used effectively on ALL the types of memory modules.

Currently, SIMMs are available in the 30-pin (8-bit) and 72-pin (32-bit) varieties, and DIMMs are available for use with 64 bit CPUs in 168-pin (64-bit) versions and for space constrained applications (notebook PC and other small form factors) in a SODIMM (small outline DIMM) 72-pin (64-bit) version.

XVIII.D.6.b. Common Memory Tests:

The following memory tests verify memory and report the specific failing bits in addition to the specific address at which the failure(s) occurred. All tests run continuously until the user intervenes by pressing the <ESC> key.

Common memory menu selections that appear in Main, Extended, and Expanded Memory subsections include:

XVIII.D.6.b.i. Abbreviated Memory Test:

All of the installed memory is subjected to four types of write/read/compare tests: ALLZEROS, ALLONES, CHECKERBOARD, and ADDRESS.

XVIII.D.6.b.ii. Extensive Memory Test:

The diagnostic routines performed under this option are exactly the same as the Abbreviated System Test, except for the addition of the MARCHING ONES test and the WALKING ONES test. It may be used to burn-in a system (running it under stress for an extended period of time to certify operation), to detect intermittent failures, or to certify newly installed/repaired memory modules/boards.

XVIII.D.6.b.iii. ALLZEROS Memory Test:

In this test, zeros are written to all memory locations, followed by a read/compare operation. When a memory location does not contain a zero, an error code is reported.

XVIII.D.6.b.iv. ALLONES Memory Test:

This test is functionally the same as the ALLZEROS Test except that ones are written to all memory locations.

XVIII.D.6.b.v. CHECKERBOARD Memory Test:

This test alternately writes zeros and ones to successive memory locations and then performs read/compare operations. If the memory location does not contain the correct value, an error code is displayed.

NOTE: The ALLZEROS, ALLONES, and CHECKERBOARD tests all produce a data pattern that naturally has an "even" parity, thus if the parity module is failing in a "high" state or is not present, it would not be detected by these tests. If a parity module is suspect, use the ADDRESS Memory Test to verify.

XVIII.D.6.b.vi. ADDRESS Memory Test:

This test generates data that produce approximately the same number of bytes with an even number of ones as with an odd number of ones, generating greater stress conditions for the parity generators.

XVIII.D.6.b.vii. MARCHING ONES Memory Test:

Using THREE different data patterns, this test writes to, reads from, and compares with all specified memory locations. This test is more stringent than the above tests.

XVIII.D.6.b.viii. WALKING ONES Memory Test:

Using NINE different data patterns, this test writes to, reads from, and compares with all specified memory locations. This is the most stringent memory test.

NOTE: The WALKING ONES Memory Test can take a considerable amount of time to run. The length of the test depends upon the amount of memory being tested and the speed of the computer. If a specific area of memory is suspect, testing time may be reduced by using the Select Memory Testing Range option to limit the area of memory tested.

XVIII.D.6.b.ix. Select Memory Testing Range:

This function allows the user to select the memory address range to be tested. One of the primary reasons for selecting an alternate memory testing range in Main Memory is to permit the

testing of the portion of memory in which **#1-TuffTEST-Pro** normally resides the 172K segment of memory between 24K (0602h) and 196K (3112h) and the reserved 21.5K segment of memory between 2.5K (00A0h) and 24K (0602h).

NOTE: The 2.5K segment of memory between 0K (0000h) and 2.5K (00A0h) cannot be tested. This area of memory contains the system's BIOS interrupt vectors and data tables.

The primary reason for selecting an alternate memory testing range in Extended Memory is to isolate a suspect subset of memory for more exhaustive testing. When Select Memory Testing Range is chosen, a prompt asks for the beginning address. When the address has been entered, it is automatically loaded into the Start portion of the test range. A prompt then asks for the ending address. It is loaded into the End portion of the Test Range.

Addresses may be entered either in a hexadecimal ("h") paragraph format or in a decimal kilobyte format.

XVIII.D.6.b.ix.a. Default Range (Main Memory):

This line indicates the default memory test range.

XVIII.D.6.b.ix.b. Alternate Range (Main Memory):

This line indicates the suggested alternate testing range [00A0h (2.5K) through 739Ch (462K)] and the area of memory that **#1-TuffTEST-Pro** will relocate to if the suggested alternate range is selected [739Dh (462K) through A000h (640K)].

NOTE: The actual address may vary slightly from system to system due to each system's BIOS.

XVIII.D.6.b.ix.c. Test Range (Extended Memory):

This line indicates the actual testing range. When Select Memory Testing Range is first selected, this line will be the same as the Default Range line. When an alternate range is selected, it will be displayed on this line.

After selection of the memory test range, the type of memory test to be performed must be selected (ALLZEROS, ALLONES, etc.).

XVIII.D.6.b.x. Display Error Log:

This selection displays the Error Log. See the Error Logging Menu section in Section **XVIII.C** for complete information.

XVIII.D.6.c. Testing Variations in the Extended Memory Menu

XVIII.D.6.c.i. Test Compaq Reserved Memory:

The Compaq 386/20 series uses a memory mapping scheme that allows the memory area between 640K and 1024K to be used as extended memory. This memory is mapped to the area just prior to 16MB. Therefore, standard memory tests won't work. To test this memory, select: K) Test Compaq Reserved Memory. The following tests are performed against this reserved memory: ALLZEROS, ALLONES, CHECKERBOARD, ADDRESS, and MARCHING ONES.

XVIII.D.6.d. Testing Variations in the Expanded Memory Menu

XVIII.D.6.d.i. Test Controller:

This test writes values to the page mapping register bits on the controller and then reads them back. If discrepancies are detected between the write and read operations, an error is displayed.

XVIII.D.6.d.ii. Select Base Memory Segment:

Expanded memory uses one of the two available base memory segments between 640K and 1M for data I/O between main and expanded memory. If unusual results occur while within the expanded memory tests, the base memory segment that had not been tested previously should be tested.

XVIII.D.6.d.iii. Select Expanded Memory Board:

The resulting error codes within individual expanded memory tests do not indicate which memory board failed. Since **#1-TuffTEST-Pro** defaults to testing ALL installed memory boards, a single memory board should be selected when individual expanded memory tests are executed. This insures proper interpretation of any resulting error codes.

XVIII.D.6.e. Disable Cache Memory Menu:

Cache memory should not be disabled unless **#1-TuffTEST-Pro** is reporting memory problems. The Disable Cache Memory Menu is displayed upon selection of the <F7> Memory Menu when loaded on an 80386-, i486-, or Pentium-based computer. The selections are as follows:

a) Intel 80386 (SY302)

b) Compaq 80386/20

c) Mylex 80386 system board

d) ICL DRS M95 or ICL DRS i486/M75

e) all other systems - DISABLE CACHE MEMORY

*f) None of the above - DO NOT DISABLE CACHE MEMORY

*None of the above (f), bypasses cache memory disabling.

The Disable Cache Memory Menu options of **#1-TuffTEST-Pro** deal with both first- and second-level cache memory. First-level cache is found in all i486-based and later computers and is an 8K or more high-speed cache internal to the microprocessor. Second-level cache is found on 80386-, i486- and Pentium-based computers and is a proprietary caching method specific to a particular make and model of computer.

XVIII.D.6.e.i. First-Level Cache - All Other Systems:

Selecting menu option e) disables the high-speed cache imbedded in the microprocessor. Earlier versions of the i486 had problems with this cache, and when it failed, non-cache memory appeared to fail. If unusual failures are experienced when testing non-cache memory, and the failures disappear when cache is disabled, it is probable that the microprocessor's cache is the failing device.

XVIII.D.6.e.ii. Second-Level Cache:

Selecting menu options "a) - d)" disables the proprietary cache for the indicated computer. If one of these items is selected when the target computer is NOT one of those listed, unpredictable results will occur.

When cache memory is malfunctioning, symptoms may occur that appear to be failures in non-cache memory. If memory failures disappear when cache memory is disabled, it is probable that cache memory is the failing device.

NOTE: The original PC design did not anticipate cache memory and therefore did not allocate memory addresses for it. Thus, cache memory chip sets must must "borrow" memory addresses to work. Due to the numerous "proprietary" memory address swapping schemes employed by the cache memory chip set manufacturers, we know of no program that RELIABLY tests cache memory DIRECTLY.

The **most RELIABLE way to test cache memory** is to test it INDIRECTLY as follows:

1) Run the target PC with cache memory enabled and note the symptoms/error codes that you think cache memory is causing.

2) Re-boot the target PC and go into its CMOS Setup program and disable cache memory.

3) Run the target PC and if the symptoms/error codes noted in step 1) go away, cache memory is bad. If they remain, something else is the cause.

XVIII.D.6.f. Finding Failing Memory Modules:

In order to find failing memory modules, it is important to first understand how various microprocessor/bus combinations process data and use memory.

The following chart indicates the relationship between CPUs and the internal data path and bus size.

CPU Overview:

CPU or Compatible	Internal Data Path Size in Bits	Data Bus Size in Bits
8088	16	8
8086	16	16
80286	16	16
80386 SX	32	16
80386 SL	32	16
80386 DX	32	32
80486 SX	32	32
80486 DX	32	32
Pentium	32	64
Pentium Pro	32	64
Pentium II	32	64

8-BIT SYSTEM:

In an 8-bit system memory is processed 1 byte (8 bits) at a time. A byte is equal to 8 data bits (Bits 0-7) and 1 parity bit (P). Each of the 9 bits must be placed into a cell in a separate memory module or DIP. Therefore, an 8-bit system with parity must have at least one Memory Bank (Bank 0) composed of one physical row of 9 discrete memory modules or DIPs (see below). The memory capacity of each module may vary so long as all 9 modules have the same capacity and speed rating.

BANK 0 - MEMORY MODULES EXAMPLE - DIPs

XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
0	1	2	3	4	5	6	7	P

BIT POSITIONS

16-BIT SYSTEM:

In a 16-bit system, memory is processed 2 bytes (16-bits) at a time. Therefore, a 16-bit system must have at least one Memory Bank (Bank 0) composed of two 8-bit (30-pin) SIMMs or two physical rows of nine DIPs each (see below). One byte is placed into each physical row. Thus there is a LO BYTE (Row 0) and a HI BYTE (Row 1) within each bank.

BANK 0 - MEMORY MODULES EXAMPLE

ROW 0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	SIMMS
LO BYTE	XXX XXX XXX XXX XXX XXX XXX XXX XXX	DIPS
	0 1 2 3 4 5 6 7 P	
	BIT POSITIONS	
ROW 1	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	SIMMS
HI BYTE	XXX XXX XXX XXX XXX XXX XXX XXX XXX	DIPS
	8 9 10 11 12 13 14 15 P	
	BIT POSITIONS	

32-BIT SYSTEM:

In a 32-bit system, memory is processed 4 bytes (32 bits) at a time. Therefore, a 32-bit system must have at least one Memory Bank (Bank 0) composed of four 8-bit (30-pin) SIMMS or one 32-bit (72-pin) SIMM or four physical rows of nine DIPs each (see below). One byte is placed into each physical row. Thus there is a LO WORD/LO BYTE (Row 0), a LO WORD/HI BYTE (Row 1), a HI WORD/LO BYTE (Row 2), and a HI WORD/HI BYTE (Row 3) within each bank.

NOTE: One 32-bit SIMM equates to the four 8-bit SIMMS shown in Rows 0, 1, 2 and 3.

BANK 0 - MEMORY MODULES EXAMPLE

ROW 0	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	SIMMS
LO WORD,	XXX XXX XXX XXX XXX XXX XXX XXX XXX	DIPS
LO BYTE	0 1 2 3 4 5 6 7 P	
	BIT POSITIONS	
ROW 1	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	SIMMS
LO WORD,	XXX XXX XXX XXX XXX XXX XXX XXX XXX	DIPS
HI BYTE	8 9 10 11 12 13 14 15 P	
	BIT POSITIONS	
ROW 2	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	SIMMS
HI WORD,	XXX XXX XXX XXX XXX XXX XXX XXX XXX	DIPS
LO BYTE	16 17 18 19 20 21 22 23 P	
	BIT POSITIONS	
ROW 3	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX	SIMMS
HI WORD,	XXX XXX XXX XXX XXX XXX XXX XXX XXX	DIPS
HI BYTE	24 25 26 27 28 29 30 31 P	
	BIT POSITIONS	

64-BIT SYSTEM:

In a 64-bit system, memory is processed 8 bytes (64 bits) at a time. Therefore, a 64-bit system must have at least one Memory Bank (Bank 0) composed of two 32-bit SIMMs or one 64-bit

DIMM. In 64-bit systems the Bit Failure Packet scheme (See Section **XVIII.D.6.g.iii** for Bit Failure Packet explanation) is not used, and in its place the actual address of the failing bit(s) is displayed.

XVIII.D.6.g. Finding Bit 0, Bank 0, and Parity:

Regardless of the size or configuration of the memory modules, it is always important to locate Bit 0 of Bank 0 as a point of reference. While the concept now is somewhat inappropriate due to the advances in technology, the original IBM PC, which had 16K memory modules, reserved Bank 0 (the first 16K) to be used for the vector tables and other information that would be loaded at power-on start-up time by the system's BIOS and Power-On Self Test. While in reality the information only occupies a small portion of the 16K bank size, this was a soldered versus socketed bank (physical row) to ensure its integrity. Today with 256K and 512K DIPs and larger SIMMs/DIMMs, the same Bank 0 approach has been preserved. Regardless of the current technical viability of the original approach, it is the norm today that if Bank 0 is disabled, then the computer will not operate beyond the Power-On Self Test.

On a system board or an add-in board, some manufacturers have screen-printed orientation information on the board. With those that have the bank and module position screen-printed, it is fairly easy to find the first bit position (Bit 0) of Bank 0. For those that do not, a process of elimination in conjunction with the **#1-TuffTEST-Pro** error codes will clearly identify Bit 0 of Bank 0, as well as the location of the parity bit. Note in the following section that in some cases the parity bit precedes Bit 0 and in others it follows Bit 7.

XVIII.D.6.g.i. Memory Module Orientation - 8-Bit Systems:

In most cases, 8-bit systems from different manufacturers do not have the same memory module orientation. The Parity bit and the 0 or 7 bit may be on either end of the row.

To determine the physical layout of an 8-bit system's DIP memory modules:

1) Remove the first and second DIP modules in any bank except Bank 0.

```
MODULES      XXX XXX XXX XXX XXX XXX XXX XXX XXX     DIPS
              |   |
              |   |
             Remove these 2 DIP modules.
```

   NOTE: If there is more than one row of DIPs and you accidentally remove DIPs in Bank 0, the computer will not operate.

2) Load **#1-TuffTEST-Pro** and select Diagnostic Menu <F5>. Within this menu select the option Memory Test <F7>. Run one of the memory tests and an error code will be generated. See Section **XVIII.D.6.h** for error code interpretation. Use the xxP Bit Failure Packet portion of the error code and the Memory Bit Position Failure Chart in Section **XVIII.D.6.i** to identify the failed bits. See Section **XVIII.D.6.g.iii** for Bit Failure Packet explanation.

If the xxP error code is 01P (equal to oooo oooF on the Chart), the Bit-7 module and the Parity Bit module failed. Therefore, the DIP memory module layout in the row would be the parity bit

module followed by the Bit-7 module.

```
MODULES     XXX XXX XXX XXX XXX XXX XXX XXX XXX
            P   7   6   5   4   3   2   1   0
                      BIT POSITION
```

If the xxP error code is 80P (equal to Fooo oooo on the Chart), the Bit-0 module and the Parity Bit module failed. Therefore, the DIP memory module layout in the row would be the parity bit module followed by the Bit-0 module.

```
MODULES     XXX XXX XXX XXX XXX XXX XXX XXX XXX
            P   0   1   2   3   4   5   6   7
                      BIT POSITION
```

If the xxP error code is C0* (equal to FFoo oooo on the Chart), the Bit-0 and Bit-1 modules failed and the Parity Bit module passed. Therefore, the DIP memory module layout in the row would be the Bit-0 module followed by the Bit-1 module with the parity bit module to the far right of that physical row.

```
MODULES     XXX XXX XXX XXX XXX XXX XXX XXX XXX
            0   1   2   3   4   5   6   7   P
                      BIT POSITION
```

If the xxP error code is 03* (equal to oooo ooFF on the Chart), the Bit-7 and Bit-6 modules failed and the Parity Bit module passed. Therefore, the DIP memory module layout in the row would be the Bit-7 module followed by the Bit-6 module with the parity bit module to the far right of that physical row.

```
MODULES     XXX XXX XXX XXX XXX XXX XXX XXX XXX
            7   6   5   4   3   2   1   0   P
                      BIT POSITION
```

NOTE: Some systems have 18 modules in a row versus the standard 9 (parity plus 8 bits or 8 bits plus parity). The same decoding technique as above can be used, but you must visually note the end of the first bank and the beginning of the second bank within the physical row.

NOTE: Later IBM XT and compatible systems and later IBM AT and compatible systems, contain larger and perhaps mixed size memory modules. In those cases you first need to use **#1-TuffTEST-Pro** to determine the size of the main memory, which is usually 640K, then through simple mathematics and visual inspection of the main memory area on the system board, determine how many rows there are, and through simple division determine which rows are combined into what banks. Then using the same approach of pulling two modules beside each other, typically as a starting point in the upper left-hand corner, you can determine whether it's Bank 0 (the computer will not operate). Then move on to the next row below it to determine what bits are failing and with the same logic as above, determine the bank and row. Through the process of elimination, the physical layout of the memory modules can be mapped.

XVIII.D.6.g.ii. Memory Module Orientation - 16-Bit, 32-Bit and 64-Bit Systems

A 16-bit system must have at least two 8-bit (30-pin) SIMMs or or two physical rows of nine DIPs

each (LO BYTE and HI BYTE), but can have more rows, always in sets of two. The module/SIMM size (64K, 256K, 512K, 1MEG, etc.) does not matter. If it only has two 8-bit SIMMs or nine DIP rows, those will be Bank 0.

Earlier 32-bit systems had four 8-bit (30-pin) SIMMs. If the system has only four 8-bit SIMMs, then those constitute Bank 0. If there are more than four, then the next set of four would represent Bank 1, and so on. More recent systems have 32-bit (72-pin) SIMMs. If the system has only one 32-bit SIMM, then it constitutes Bank 0. If there is more than one, then the next one would represent Bank 1, and so on.

A 64-bit system must have at least two 32-bit SIMMs or one 64-bit DIMM, but can have more, always in sets of two or one respectively. If it only has two 32-bit SIMMs, or one 64-bit DIMM, those will be Bank 0.

> NOTE: If the system has an interleaved memory board, the CMOS interleave value should be set to OFF, or disabled. And if the system has cache memory, that also should be set to OFF, or disabled, to effectively use the procedure to find the failing bit in the failing memory module, thus identifying which physical module is to be replaced.

> NOTE: It is important, through physical examination of the printing/coding on the module, to determine the speed of the memory modules installed in the system. The modules' speed within Memory Banks should always be identical otherwise problems could occur. When you must use different speed memory modules in different Memory Banks, always put the slower modules in Bank 0 because the CPU uses BANK 0 to calibrate the system's memory speed. A 120 NS speed is relatively slow, where an 70 NS or faster speed is a more efficient module.

It is assumed that if a memory module is removed from Bank 0, the system will not operate. Thus by using a module removal approach similar to what was described in the prior section regarding DIP-type memory modules, Bank 0 can be located in systems with more than one Memory Bank. However, it is possible to have a bad bit in Bank 0 (within the SIMMs/DIMMs) and the system may continue to operate. In general this would indicate that the bad bit is above the 2.5K that the BIOS/Power-On Self Test verifies for its reserved information loading.

If more than two 8-bit SIMMs are observed in a 16-bit system, or more than four 8-bit SIMMs or one 32-bit SIMM in a 32-bit system, or more than two 32-bit SIMMs or one 64-bit DIMM in a 64-bit system, then there is more than one Memory Bank and a procedure must be used to determine which is Bank 0.

Use the motherboard's documentation to determine the location of Bank 0. If documentation is not available check the motherboad for silk-screened legends depicting Bank 0, Bank 1, etc. If there are no silk-screen identifiers, pull the SIMM(s) from the Memory Bank closest to the front the system, as a point of reference, to determine which is Bank 0. When the SIMM(s) are removed from Bank 0 the system will not boot. If the system still boots, pull the SIMM(s) from the next Memory Bank. Repeat this procedure until the system stops booting.

Locating Failing Memory Module(s)

In systems with more than one Memory Bank, use the error code address to determine which Bank(s) contains the failing memory module(s). Then use SIMM swapping techniques to determine which memory module is bad.

Important: In a 16-bit system with two 8-bit SIMMs in a Memory Bank, a 32-bit system with four 8-bit SIMMs in a Memory Bank or a 64-bit system with two 32-bit SIMMs in a Memory Bank, if the

system operates and an error is detected, reverse the SIMMs within the Bank. If the error code address moves, the error code indicates a failing SIMM. If the error code address does not move, the error code indicates a failing socket or system board.

XVIII.D.6.g.iii. "Bit Failure Packet" Decoding Examples:

The xxP portion of the error code is referred to as the "Bit Failure Packet." Each Bit Failure Packet represents one byte composed of eight data bits, xx, and one parity bit, P. An 8-bit computer would have one Bit Failure Packet, a 16-bit computer would have two Bit Failure Packets, and a 32-bit computer would have four Bit Failure Packets.

> NOTE: All **#1-TuffTEST-Pro** memory error code Bit Failure Packets are decoded via the Memory Bit Position Failure Chart in Section **XVIII.D.6.i**. The Memory Bit Position Failure Chart is a hexadecimal/binary translation chart depicted in such a way as to not burden the user in trying to understand the binary relationship to the failing bit or in performing hexadecimal math calculations.

An **8-bit system** with the error code xxP = 28* (equal to ooFo Fooo on the chart) would indicate that bits 2 and 4 failed and the parity bit passed (* equals parity passed and **P** equals parity failed). The following graphic indicates the physical bit layout of the modules (**DIPs**) with their bits indicated below and the "xx" error code status indicated above.

	1st "x"				2nd "x"				1st P
xxP VALUE	o	o	**F**	o	**F**	o	o	o	*
DIPs	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
BIT POSITION	0	1	2	3	4	5	6	7	P

A **16-bit system** with the error code xxPxxP = 40*22P (equal to oFoo oooo ooFo ooFo on the chart) indicates that the LO BYTE bit 1 and HI BYTE bits 10 and 14 and the second parity bit failed.

		1st "x"				2nd "x"				1st P
LO BYTE	xxP VALUE	o	**F**	o	o	o	o	o	o	*
	DIPs	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	BIT POSITION	0	1	2	3	4	5	6	7	P

		3rd "x"				4th "x"				2nd P
HI BYTE	xxP VALUE	o	o	**F**	o	o	o	**F**	o	**P**
	DIPs	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	BIT POSITION	8	9	10	11	12	13	14	15	P

LO BYTE	**SIMM** BITS	XXXXXXXXXXXXXX 0 7	bit 1 failed	1st xxP(40*)
HI BYTE	**SIMM** BITS	XXXXXXXXXXXXXX 8 15	bits 10, 14 and parity failed	2nd xxP(22P)

A **32-bit system** with the error code xxPxxPxxPxxP = 00*01P08*00* (equal to oooo oooo oooo oooF oooo Fooo oooo oooo on the Chart) indicates that the LO WORD/HI BYTE bit 15 and the parity bit failed and HI WORD/LO BYTE bit 20 failed.

```
        LO      SIMM  XXXXXXXXXXXXX  OK                  1st xxP(00*)
LO      BYTE    BITS  0            7
WORD
        HI            SIMM  XXXXXXXXXXXXX  bit 15 and        2nd xxP(01P)
        BYTE    BITS  8           15  parity failed

        LO      SIMM  XXXXXXXXXXXXX  bit 20 failed     3rd xxP(08*)
HI      BYTE    BITS  16          23
WORD
        HI      SIMM  XXXXXXXXXXXXX  OK                  4th xxP(00*)
        BYTE    BITS  24          31
```

A **64-bit system** does not use the Bit Packet Packet orientation as the error code contains the actual address of the failure.

XVIII.D.6.h. Memory Error Codes:

Due to the architectural differences of personal computer types and **#1-TuffTEST-Pro's** testing precision, there are slight variations of the basic memory error code format for the various computer types as follows.

XVIII.D.6.h.i. Main Memory - 8088- and 8086-based Computers:

The Main Memory error code format is MTt-BbxxP (in Certification and Diagnostic Abbreviated and Extended Tests) or MTt-BbaaaaxxP (in Error Logging), where:

M = Main Memory

T = Test type where:
- A = Abbreviated
- E = Extensive
- S = Single

t = Test number of specific test where:
- 1 = ALLZEROS
- 2 = ALLONES
- 3 = CHECKERBOARD
- 4 = ADDRESS
- 5 = MARCHING ONES
- 6 = WALKING ONES

B = Bank number (64K)

b = Block number (16K) within bank

aaaa = Address within bank, 0000 -FFFF (Error Logging)

xxP = Bit failure packet where:
- xx = Failed bits
- P = Letter P for parity error (asterisk [*] if no parity error)

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, to decode xxP Bit Failure Packets.

XVIII.D.6.h.ii. Main Memory - 80286-based Computers (ISA):

Main Memory error code format is MTt-BxxPxxP where:

M = Main Memory

T = Test type where:
- A = Abbreviated
- E = Extensive
- S = Single

t = Test number of specific test where:
- 1 = ALLZEROS
- 2 = ALLONES
- 3 = CHECKERBOARD
- 4 = ADDRESS
- 5 = MARCHING ONES
- 6 = WALKING ONES

B = Bank number (256K banks)

xxP = Bit failure packet for each xxP, where:
- xx = Failed bits
- P = Letter P for parity error (asterisk [*] if no parity error)

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, to decode xxP Bit Failure Packets.

XVIII.D.6.h.iii. Main Memory - 80386- and i486-based Computers (ISA/EISA/VLB/PCI):

Main Memory error code format is MTt-xxPxxPxxPxxP, where:

M = Main Memory

T = Test type where:
- A = Abbreviated
- E = Extensive
- S = Single

t = Test number of specific test where:
- 1 = ALLZEROS

2 = ALLONES
3 = CHECKERBOARD
4 = ADDRESS
5 = MARCHING ONES
6 = WALKING ONES

xxP = Bit failure packet for each xxP, where:
xx = Failed bits
P = Letter P for parity error (asterisk [*] if no parity error)

NOTE: The Bit Failure Packets in the 80386SX error code are redundant. The first pair of Bit Failure Packets display exactly the same information as the second pair.

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, to decode xxP Bit Failure Packets.

XVIII.D.6.h.iv. **Main Memory - Pentium, Pentium Pro, and Pentium II-based Computers (ISA/EISA/VLB/PCI):**

Main Memory error code format is MTt-f-aaaaaaaa where:

M = Main Memory

T = Test type where:
A = Abbreviated
E = Extensive
S = Single

t = Test number of specific test where:
1 = ALLZEROS
2 = ALLONES
3 = CHECKERBOARD
4 = ADDRESS
5 = MARCHING ONES
6 = WALKING ONES

f = Type of failure where:
Bit = only a data bit failed ("B" in Error Log)
Parity = only a parity bit failed ("P" in Error Log)
Bit&Parity = both a data bit and a parity bit failed ("B&P" in Error Log)

aaaaaaaa = address of failing data bit

XVIII.D.6.h.v. **Main Memory - IBM PS/2 Models, General:**

The error codes report significant quantities of data regarding locations of errors. Models of the PS/2 family, however, provide no opportunity for specific chip replacement (except PS/2 Model 25) because of the surface-mounted technology used and the SIMM packages. *#1-PC Diagnostics Company*, nevertheless, decided to retain the detailed error reporting in anticipation

of PS/2 compatibles entering the market using potentially different memory configurations.

XVIII.D.6.h.vi. **Main Memory - IBM PS/2 Models 25 and 30:**

The Main Memory error code format is MTt-BbxxP (in Certification and Diagnostic) or MTt-BbaaaaxxP (in Error Logging), where:

M = Main Memory

T = Test type where:
- A = Abbreviated
- E = Extensive
- S = Single

t = Test number of specific test where:
- 1 = ALLZEROS
- 2 = ALLONES
- 3 = CHECKERBOARD
- 4 = ADDRESS
- 5 = MARCHING ONES
- 6 = WALKING ONES

B = Bank number (64K)

b = Block number (16K) within bank

aaaa = Address within bank, 0000-FFFF (Error Logging)

xxP = Bit failure packet, where:
- xx = Failed bits
- P = Letter P for parity error (asterisk [*] if no parity error)

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, to decode xxP Bit Failure Packets.

XVIII.D.6.h.vii. **Main Memory - IBM PS/2 Models 30-286, 50, 50Z, and 60:**

Main Memory error code format is MTt-BxxPxxP, where:

M = Main Memory

T = Test type where:
- A = Abbreviated
- E = Extensive
- S = Single

t = Test number of specific test where:
- 1 = ALLZEROS
- 2 = ALLONES
- 3 = CHECKERBOARD

4 = ADDRESS
5 = MARCHING ONES
6 = WALKING ONES

xxP = Bit failure packet for each xxP, where:
xx = Failed bits
P = Letter P for parity error (asterisk [*] if no parity error)

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, to decode xxP Bit Failure Packet.

XVIII.D.6.h.viii. **Main Memory -IBM PS/2 Models 55SX, 70, 80, and 90:**

Main Memory error code format is MTt-xxPxxPxxPxxP where:

M = Main Memory

T = Test type where:
A = Abbreviated
E = Extensive
S = Single

t = Test number of specific test where:
1 = ALLZEROS
2 = ALLONES
3 = CHECKERBOARD
4 = ADDRESS
5 = MARCHING ONES
6 = WALKING ONES

xxP = Bit failure packet for each xxP, where:
xx = Failed bits
P = Letter P for parity error (asterisk [*] if no parity error)

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, to decode xxP Bit Failure Packets.

XVIII.D.6.h.ix. **Extended Memory -80286-based Computers (ISA, MCA):**

Extended Memory error code format is Tat-BbxxPxxP where:

T = Extended Memory error

a = Test type where:
A = Abbreviated
E = Extensive
S = Single

t = Test number of specific test where:
1 = ALLZEROS

2 = ALLONES
3 = CHECKERBOARD
4 = ADDRESS
5 = MARCHING ONES
6 = WALKING ONES

B = Which 1MB block where the error occurred, where:
1 = between 1 and 2MB
2 = between 2 and 3MB, etc.

b = Which 64K bank (0 -Eh) within the 1MB block where the error occurred, where:
0 = 0 - 64K
1 = 65 - 128K
2 = 129 - 192K
3 = 193 - 256K
4 = 257 - 320K
5 = 321 - 384K
6 = 385 - 448K
7 = 449 - 512K
8 = 513 - 576K
9 = 577 - 640K
A = 641 - 704K
B = 705 - 768K
C = 769 - 832K
D = 833 - 896K
E = 897 - 960K
F = 961 - 1024K

xxP = Bit failure packet for each xxP, where:
xx = Failed bits
P = Letter P for parity error (asterisk [*] if no parity error)

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, to decode xxP Bit Failure Packets.

The bank in which the error occurred is reported on the display. When combined with the bit failure packet information, the exact failing memory module can be isolated.

XVIII.D.6.h.x. Extended Memory - 80386- and i486-based Computers (ISA/EISA/MCA/VLB/PCI):

Extended Memory error code format is either Tat-xxPxxPxxPxxPaaaaaaaa (most computers) or Tat-32xxPxxPxxPxxP (Acer system boards) where:

T = Extended Memory

a = Test type where:
A = Abbreviated
E = Extensive
S = Single

t = Test number of specific test where:
- 1 = ALLZEROS
- 2 = ALLONES
- 3 = CHECKERBOARD
- 4 = ADDRESS
- 5 = MARCHING ONES
- 6 = WALKING ONES

3 = State of A3 when error was detected (Acer only)

2 = State of A2 when error was detected (Acer only)

xxP = Bit failure packet for each xxP, where:
- xx = Failed bits
- P = Letter P for parity error (asterisk [*] if no parity error)

aaaaaaaa = Address

NOTE: The Bit Failure Packets in the 80386SX error code are redundant. The first pair of Bit Failure Packets display exactly the same information as the second pair.

On an 80386 Acer system board, if A2 is 0, a SIMM in an ODD-numbered socket is bad. If A2 is 1, a SIMM in an EVEN-numbered socket is bad. If A2 is B, ALL SIMMs are bad. On an 80486 Acer system board, use the following truth table:

A3	A2		Failing SIMM Module(s)
0	0	=	1 or 5
0	1	=	2 or 6
0	B	=	1 and 2, or 5 and 6
1	0	=	3 or 7
1	1	=	4 or 8
1	B	=	3 and 4, or 7 and 8
B	0	=	1 and 3, or 5 and 7
B	1	=	2 and 4, or 6 and 8
B	B	=	ALL SIMMs BAD

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, decode xxP Bit Failure Packets.

XVIII.D.6.h.xi. **Extended Memory - Pentiun-, Pentiun Pro- and Pentium II-based Computers (ISA/EISA/VLB/PCI):**

Extended Memory error code format is TAt-f-aaaaaaaa where:

T = Extended Memory

A = Test type where:
- A = Abbreviated
- E = Extensive

S = Single

t = Test number of specific test where:
- 1 = ALLZEROS
- 2 = ALLONES
- 3 = CHECKERBOARD
- 4 = ADDRESS
- 5 = MARCHING ONES
- 6 = WALKING ONES

f = Type of failure where:
- Bit = only a data bit failed ("B" in Error Log)
- Parity = only a parity bit failed ("P" in Error Log)
- Bit&Parity = both a data bit and a parity bit failed ("B&P" in Error Log)

aaaaaaaa = address of failing data bit

XVIII.D.6.h.xii. <u>Expanded Memory - IBM PC, XT, PS/2 25 and 30:</u>

Expanded Memory error code format is either Xat-BbPxxpppp (in Certification and Diagnostic) or Xat-BbaaaaPxx (in Error Logging), where:

X = Expanded Memory error

a = Test type where:
- A = Abbreviated
- E = Extensive
- S = Single
- C = Certification

t = Test number of specific test where:
- 1 = ALLZEROS
- 2 = ALLONES
- 3 = CHECKERBOARD
- 4 = ADDRESS
- 5 = MARCHING ONES
- 6 = WALKING ONES

B = Bank the error occurred in (0 -7)

b = Block (16K) of bank error occurred in (0 -F)

aaaa = Upper byte of address of error (Error Logging)

Pxx = Bit failure packet where:
- xx = Failed bits
- P = Letter P for parity error (asterisk [*] if no parity error)

pppp = Base address in hex (Certification and Diagnostic)

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, to decode xxP Bit Failure Packets.

XVIII.D.6.h.xiii. Expanded Memory - 80286-, 80386- and i486-based Computers (ISA/EISA):

Expanded Memory error code format is Xat-BxxPpppp where:

X = Expanded Memory error

a = Test type where:
- A = Abbreviated
- E = Extensive
- S = Single
- C = Certification

t = Test number of specific test where:
- 1 = ALLZEROS
- 2 = ALLONES
- 3 = CHECKERBOARD
- 4 = ADDRESS
- 5 = MARCHING ONES
- 6 = WALKING ONES

B = Bank in which the error occurred (0 -7)

xxP = Bit failure packet where:
- xx = Failed bits
- P = Letter P for parity error (asterisk [*] if no parity error)

ppp = Base address in hex (Certification and Diagnostic)

NOTE: See Memory Bit Position Failure Chart, Section **XVIII.D.6.i**, to decode xxP Bit Failure Packets.

XVIII.D.6.i. Memory Bit Position Failure Chart:

Decode the "xxP" portion of the Memory Error Code by computer type to determine failing bit(s), then bank and block decoding to locate the failing memory module(s).

```
Value of "xx":     o    =    Passing Bit (OK)
                   F    =    Failing Bit

Value of "P":      *    =    No Parity Error
                   P    =    Parity Error
```

SYSTEM TYPE	BIT POSITION				BIT POSITION			
8-BIT:								
BYTE	0	1	2	3	4	5	6	7

16-BIT:

HI BYTE		8	9	10	11		12	13	14	15
LO BYTE		0	1	2	3		4	5	6	7

32-BIT:

HI WORD									
HI BYTE	24	25	26	27		28	29	30	31
LO BYTE	16	17	18	19		20	21	22	23
LO WORD									
HI BYTE	8	9	10	11		12	13	14	15
LO BYTE	0	1	2	3		4	5	6	7

Value of: 1st "x"					2nd "x"				
0	= o	o	o	o	0	= o	o	o	o
1	= o	o	o	F	1	= o	o	o	F
2	= o	o	F	o	2	= o	o	F	o
3	= o	o	F	F	3	= o	o	F	F
4	= o	F	o	o	4	= o	F	o	o
5	= o	F	o	F	5	= o	F	o	F
6	= o	F	F	o	6	= o	F	F	o
7	= o	F	F	F	7	= o	F	F	F
8	= F	o	o	o	8	= F	o	o	o
9	= F	o	o	F	9	= F	o	o	F
A	= F	o	F	o	A	= F	o	F	o
B	= F	o	F	F	B	= F	o	F	F
C	= F	F	o	o	C	= F	F	o	o
D	= F	F	o	F	D	= F	F	o	F
E	= F	F	F	o	E	= F	F	F	o
F	= F	F	F	F	F	= F	F	F	F

XVIII.E. Help Menu <Any Menu F10>

Help screens in **#1-TuffTEST-Pro** are available from most menus by pressing the <F10> key. When Help is selected, the following choices are displayed for selection:

(a) How **#1-TuffTEST-Pro** Works

(b) When to Use **#1-TuffTEST-Pro**

(c) How to Move from Menu to Menu

(d) How to Select Functions within a Menu

XVIV. Licensing Information